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Yum-Yum in 1886:
Gilbert and Sullivan
revisited (p. 104)

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Smithsonian

Volume 14, Number 12

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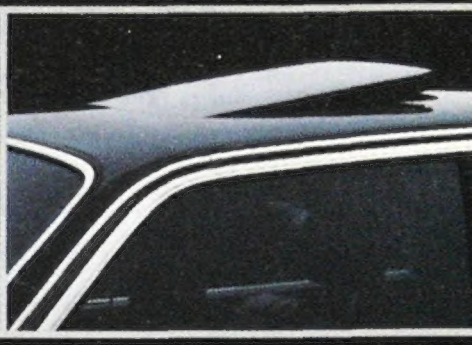

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For now, the dean of American wood carvers, William J. Koelpin, has accepted a commission from The Franklin Gallery to create just such a collection. A collection of *miniature decoys* portraying all of the 36 different kinds of wild ducks native to North America. Each decoy will be superbly detailed—hand-painted in its full natural colors. Together, they will form an unprecedented display of sporting art in a uniquely American collecting tradition.

Classics—by an acknowledged master

The art of William J. "Bill" Koelpin has won numerous awards and can be seen in major museums and private collections throughout the country. In 1974, Koelpin was chosen "Best in World" at the World Championship Wild Fowl Carving Competition in Salisbury, Maryland. He has been named "Master of the Guild" by the International Wood Carving Guild. And our nation's most prestigious wildlife museum—the Lehigh-Yawkey-Woodson Art Museum in Wausau, Wisconsin—has called him "one of America's premier artists."

Bill Koelpin's enormous talent—his artistic mastery, his accuracy and complete authenticity—will be in evidence throughout The Ducks of North America Miniature Decoy Collection.

Working directly in miniature, he has hand-carved an original master for each species of duck. From these master models, expert craftsmen take special molds, so incredibly detailed that they capture every line and curve of the sculptor's art. Each decoy in the collection is then crafted from these molds in a blend of resins and wood to create a perfect miniature. A

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Miniature Decoy Collection

BY William J. Koelpin

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Decoys, at left, shown reduced. Average length is 3 inches. The base of each decoy will bear the name of the species portrayed, the signature of the artist, and the copyright of The Franklin Gallery.

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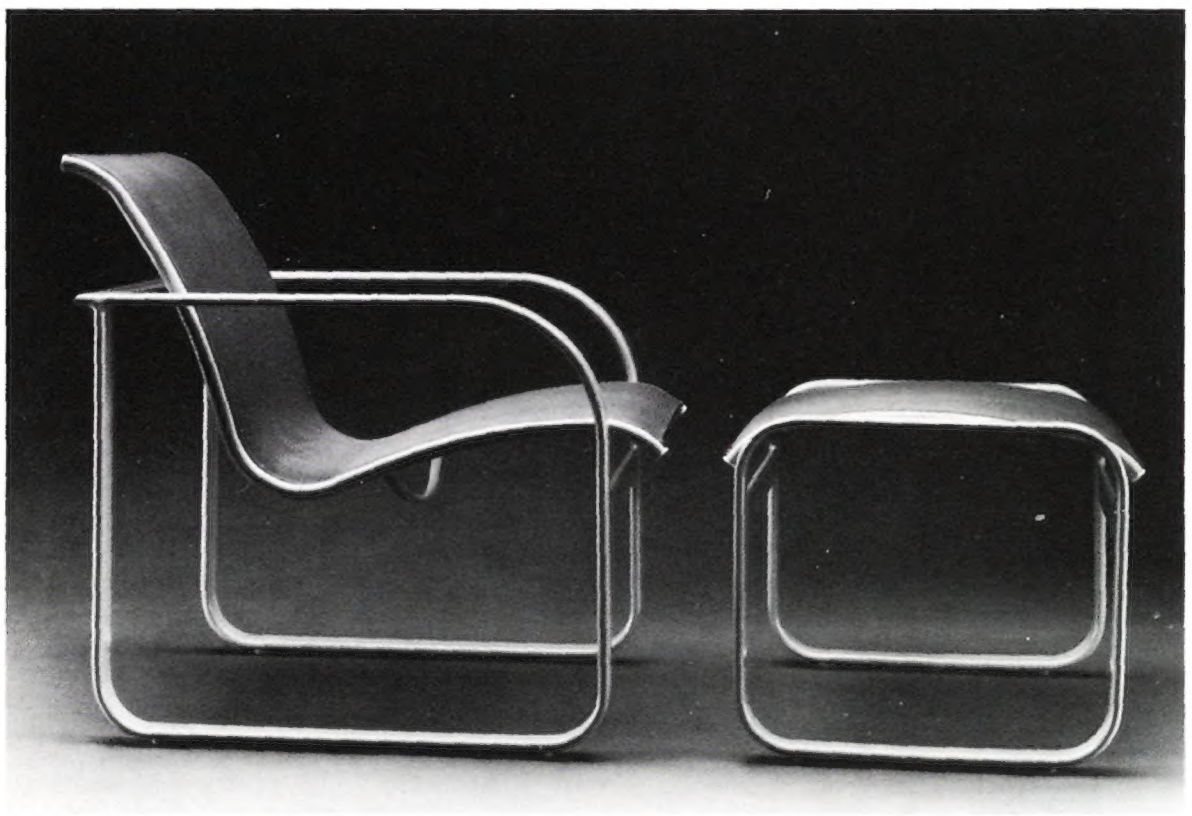

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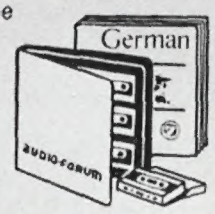

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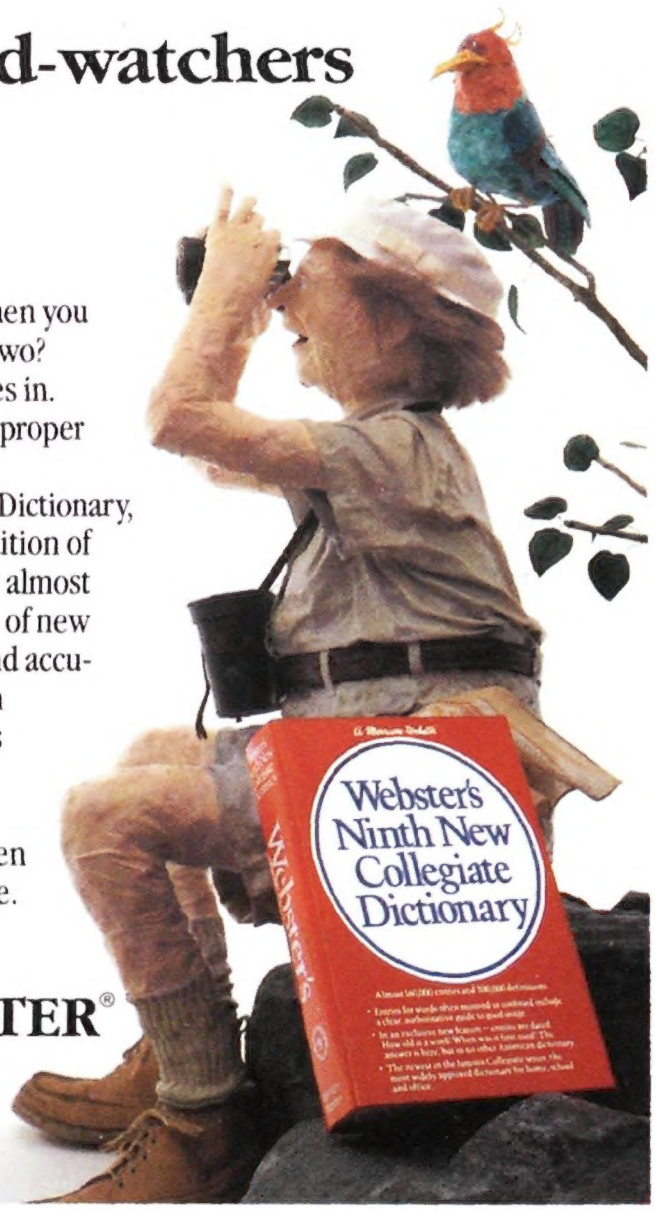

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Secretary Ripley's comments

The view from the castle

Work proceeds apace on our Center for African, Near Eastern and Asian Cultures, thanks to the support of the Associates

A year ago in February, SMITHSONIAN devoted part of an issue to an appeal for support for the Quadrangle, our Center for African, Near Eastern and Asian Cultures to be constructed at the Institution. Lying between Independence Avenue and the old castle, the Center is to be built largely underground, with new gardens on top, two delicate pavilions on either side of a gateway opening onto the Avenue, and a graceful kiosk entrance nearer the Mall.

In that issue of the magazine we made our first request to all the Associates, asking them to help us raise one-half of the $75 million needed to complete this novel structure. It will be the first of its kind to combine museum galleries with an International Center, provision for specialized studies in Islamic cultures, and a program of changing exhibits, seminars, discussions and traditional folk performances from that vast region between the west coast of Africa and the Philippines, Japan and Korea.

Congress had given us one-half of the necessary funds, and we had embarked on a public campaign to raise the other half from here and abroad, feeling that many of the nations in the area would want to contribute to such a noble cause. How have we fared in the past year? So far, fund-raising efforts directed at the Associates have brought in more than 37,000 responses for a grand total of $1,438,974, with occasional checks still coming in. This has been a remarkable expression of support from across the country, and a demonstration of our membership's understanding and loyalty.

Meanwhile, members of the National Associates Board have raised almost $3 million from among themselves and corporations with which they are associated. A separate committee of the Board has joined with our own Development Office on a corporate-giving campaign, directed essentially at businesses with strong overseas ties in the area. There are about 90 nations in the vast arc of countries lying from the bulge of Africa east through Asia. Corporations have only begun to respond, but I am sure that they will.

Foreign governments and organizations have given more than $8 million to date; others have been asked to make contributions of money or in the form of gifts or loans of objects, or changing exhibitions for the future. The Smithsonian itself has pledged nearly $10 million from our private resources. Thus the Institution will have put in a good percentage of the amount needed for construction from our own funds.

We shall appeal to foundations, of course, both here and abroad, especially those interested in international exchange and education. The declining fortunes of the United States in the Middle East should certainly galvanize intelligent Americans to support any possible way of convincing the nationals of the countries there that America respects them even as we would be respected.

Now we are close to our goal, although we are still short of the total we need for construction. Meantime, ground has been broken. The work proceeds apace. Truly, in two years or so we shall have here a "college of discoverers" such as Joseph Henry once envisaged. Our Center should presage a new, excitingly expanded role for the Smithsonian.

S. Dillon Ripley

Everybody starts at the bottom.

Real winning comes in not staying there. In United States Diving, young people learn that it's okay to be afraid, that there's no shame in failing. And as they learn to dazzle the air and knife the water, they learn something much more important. That the most soaring triumphs are in simply trying again.

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Letters to the Editor

Bats

Dear Sir: I hope Merlin Tuttle's article does its bit in removing the vast prejudice against this useful mammal. I became fond of these charming creatures 35 years ago, while my husband was doing his dissertation on the vision of bats and owls. He had a dozen of them—*Myotis lucifugus* and *Eptesicus fuscus*—in a cage in our small apartment, and we would exercise them by letting them fly back and forth in our little hallway. But the most fun was when he would put one of the soft, furry little gnomes on the tray of our baby daughter's high chair, take her hand and help her stroke it. Her very first word was "bats"—applied to her father as well.
Betsy Curtis
Saegertown, Pennsylvania

Dear Sir: We have had ten years of living with these great creatures. It all started with restoring an 1820 stone farmhouse. Situated next to two streams, the house was a great drawing card for bats. I read about the bats of central Pennsylvania—nothing to fear. But they *would* keep the insect population to a minimum, so every effort was made not to harm them. Every spring, returning bats take up residence in the barn and nearby buildings, from where they continue to work for us all summer long.
Stan Smith
Boalsburg, Pennsylvania

Dear Sir: We spelunkers are frequently in contact with the furry little critters, and as a group are some of the greatest supporters of bat conservation.
Tony Grieco, Secretary
Permian Basin Speleological Society
Midland, Texas

Dear Sir: *Your caption on page 77* laments that guano "production is dropping." Hasn't it always been?
Michael P. Donovan
Morgantown, West Virginia

Kandinsky

Dear Sir: I have an authorized lithograph of Kandinsky's *Yellow, Red, Blue*. One of us has it upside down.
Allen Baxter
Radnor, Pennsylvania
We do. Kandinsky righted is below. Ed.

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Falkland Islands

Dear Sir: Nicholas Dean gives no indication of having spent much time researching the Argentine point of view of the Falkland Islands war.

Eventually these islands, the Malvinas, will be reunited with the Argentine Republic; they are part of Argentine soil. The 151 years of occupation and the ethnographic changes imposed by the British do not alter facts. Foresight about this is in the best interests of the British people and nation, and the inhabitants of the residual colonies.

Knud Laurlund
San Rafael, California

Dear Sir: Nicholas Dean's article should have been titled "Aftermath of the war in the Falkland/Malvinas Islands." The United Nations and our State Department use "Falklands (Malvinas)," which properly reflects the controversial and still-unresolved nature of the conflict involving those islands.

Celso Rodriguez
Falls Church, Virginia

High Museum

Dear Sir: The new High is like so much of modern art—a flash-grab of attention, an object serving only the creator's ego.

The atrium consists of blank white spaces and a wedge of empty pavement; one longs for a lone piece of sculpture or a fountain.

On the wretchedly narrow ramp, even two people side by side feel cramped. A two-way street, it is a pedestrian traffic jam, with people moving at snail's pace up and down, walking on the "wrong" side, and children clinging to the railing, further impeding traffic.

The sign listing exhibits and where they can be found is tucked into an alcove next to the elevator. The continuity of the ramp is disorienting—no signs indicate at which floor one has arrived, or where to find a particular gallery. Tired feet are ignored mercilessly. No benches. My enjoyment of my favorite painting is curtailed by being forced to stand and be jostled by passersby.

National encomiums notwithstanding, I suspect this is the architectural equivalent of the Emperor's new clothes.

Jean DeMouy
Avondale Estates, Georgia

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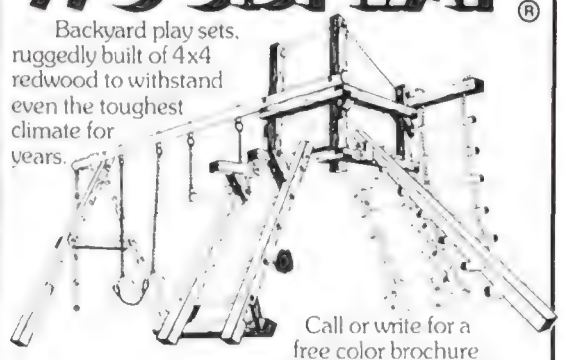

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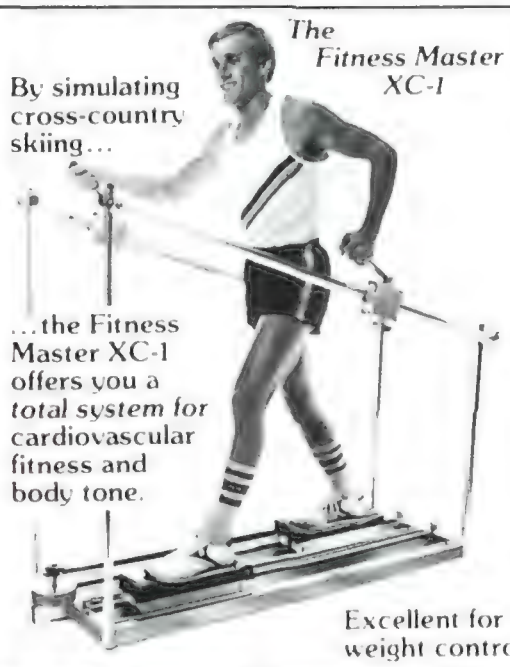
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Even if you've never built a model before, you can experience the relaxing pleasure and pride of accomplishment that is offered by this fascinating hobby. You can build the *Swift*. The secret's in our kit, designed especially for the first time modeler, with pre-cut parts that make assembly easy. Clear, large scale plans and instructions that virtually take you by the hand and guide you every step of the way through hours of the most relaxing fun you'll ever have. And when completed—a museum quality model you'll display with pride, with gleaming brass fittings, walnut planked hull, delicate rigging—lifelike in every detail.

Quality you can see and feel

The materials in our kit may be better than those used in the original *Swift*. The keel section and frames are pre-cut plywood, ready for quick assembly. The *Swift's* hull is planked twice; once with thick, flexible limewood for strength, then overlaid with planks of African walnut for lasting beauty.

You won't have to make the fittings—we've done that for you. Our kit contains ready-to-use blocks and deadeyes of rare, yellow boxwood. We include eyelets, bracers and belaying pins—over 70 parts of solid brass! Even the cabin door hinges are brass, as are the 250 miniature nails you'll use to fasten the planking to the hull and deck. And, since the original wooden *Swift* had no plastic parts, our kit doesn't either—*anywhere!*

Creative? And how! Overwhelming? Not a bit! But be prepared for hours of the most challenging, engrossing, relaxing fun you've ever had.

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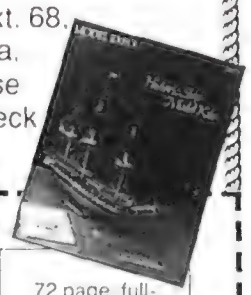

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Maxine Schuler
Child Day Care Association
St. Louis

Dear Sir: The American Nanny Plan, an organization which trains and supervises American nannies to work in American households, has just graduated its first class. Our program is new and still growing, but we plan to establish and provide high standards of professional child care similar to those the Norland nannies have represented for decades.

Deborah Davis, PhD
American Nanny Plan
Claremont, California

Harriet Quimby

Dear Sir: Terry Gwynn-Jones' mention of the daredevil aviator Lincoln Beachey brings to mind an unusual race that I witnessed at the old Brighton Beach dirt track around 1914.

My oldest brother drove me to the track on his Indian motorcycle. We parked right alongside the wooden barrier and stood on the bike's seat for a good view over the fence.

Beachey, "The Demon of the Sky," in a Curtiss biplane, was pitted against the very famous Barney Oldfield, "The Daredevil of the Earth," driving a Christie racing car. Oldfield was to circle the dirt track and Beachey to do the same in the air. As I recall, the race did not take long nor did it appear to be conclusive. In fact, to my youthful perception this whole episode was utterly ridiculous.

Henry R. Awad
Bronx, New York

Dear Sir: I can sympathize with Harriet Quimby, for I had a similar experience. As a young reporter on the *Brooklyn Times* in 1927, I discovered that the New York City comptroller was refusing to pay, as exorbitant, a court's award of fees to

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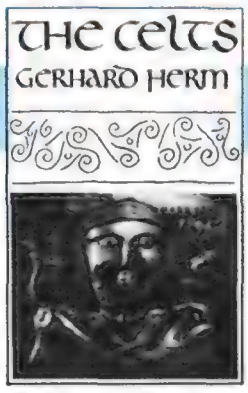

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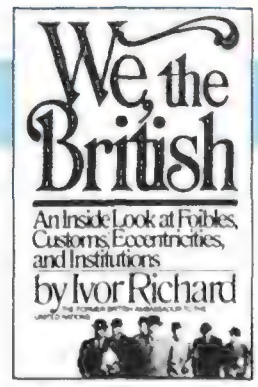

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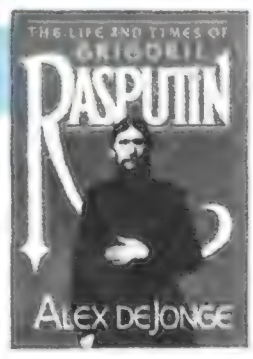

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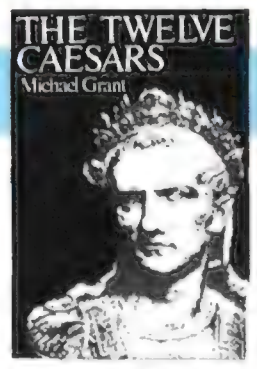

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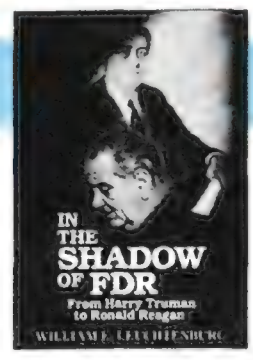

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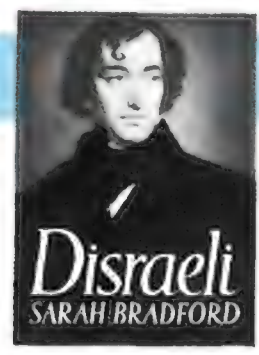

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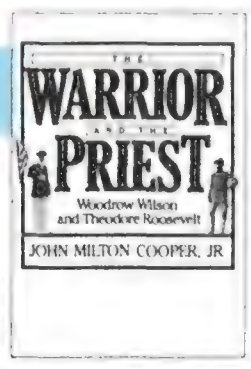

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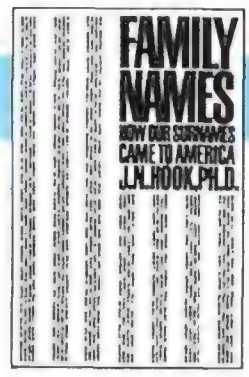

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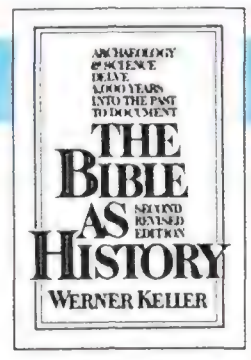

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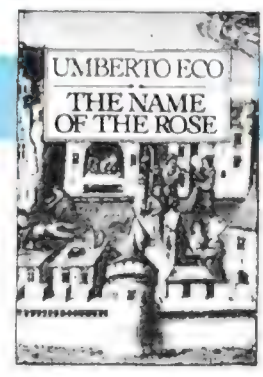

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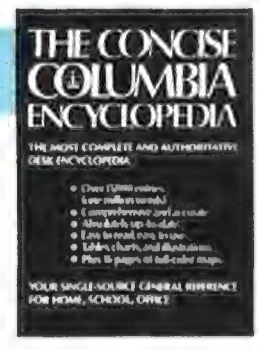

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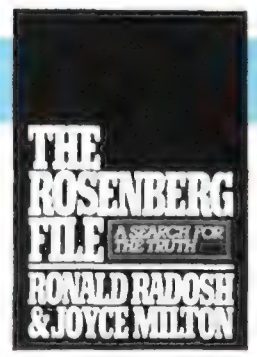

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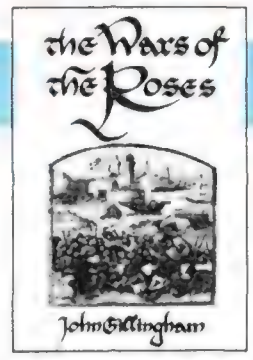

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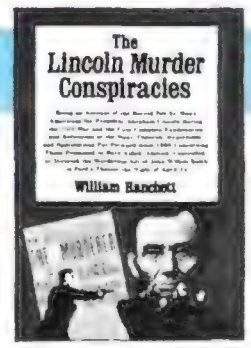

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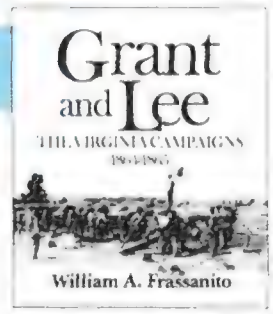

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a psychiatrist and a lawyer who testified at a murder trial. I envisioned a banner headline: CITY REBUFFS JUDGE, HOLDS UP HUGE FEES. Surely, the *New York Times, Herald Tribune, Brooklyn Eagle* and other newspapers would pick up my scoop and I'd be famous as a newsman in New York for a day.

Alas! Charles A. Lindbergh landed the *Spirit of St. Louis* in Paris and buried my story. Even my own paper had trouble squeezing it onto the front page.

J. A. Livingston
Philadelphia

Dear Sir: As an aviation curator with a particular interest in women in aviation, I was pleased to see your article. The women who were flying before World War I have been too long forgotten.

This truly elegant photograph of Harriet Quimby [below] may have inspired the artist who did her lost portrait for the Bohemian Club.

Claudia M. Oakes
Washington, D.C.

Niagara Falls

Dear Sir: Your article reminded me of something that happened nearly 30 years ago, when I was working at an advertising agency on a leading New England beer account.

The brewery produced a major portion of all the beer consumed in New England, and felt that an ad campaign might be based on relating their annual production to the amount of water flowing over Niagara Falls. A team of engineers with slide rules spent several days at the falls and several more at the brewery. Their conclusion: the entire annual production of beer and ale would go over the falls in just three-tenths of one second!

The campaign was scrapped.

Jeremy D. Sprague
New York City

Dear Sir: Gary Walther says Niagara Falls isn't the world's highest. It isn't even the highest in New York State. How many people driving to Niagara via the New York Thruway or U.S. 20 are aware that just a few miles to the south, near Ithaca, Taughannock Falls plunges over a cliff in a sheer drop of 215 feet?

Of course, in comparison with Niagara's volume Taughannock is a mere trickle, but it is a most spectacular sight nevertheless.

George Mackie
Nokomis, Florida

Mall

Dear Sir: While very different from our traditional Southern black-eyed peas and hog jowl, the moin moin recipe was timed just right for New Year's when, to ensure good luck in the coming year, one *must* have black-eyed peas.

You said that "recipes are a big first for this column and probably an even bigger last." We urge Edwards Park to reconsider. Cuisine is a legitimate art. Recipes, as much as the pots and pans in which they are prepared and the dishes on which they are served, reflect the culture, mores and habits of geographic areas.

Amy Wright Ricks
Huntsville, Alabama

Veil of cashmere

Dear Sir: When my husband introduced me to the rigors of duck shooting, I never was warm enough—until I found an Abercrombie & Fitch box under the Christmas tree. Cashmere long johns! Now I can assure unbelievers that I am toasty on a frosty morning.

Dorothy Feist
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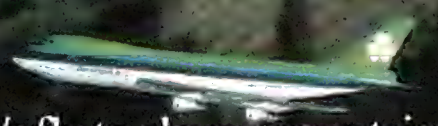

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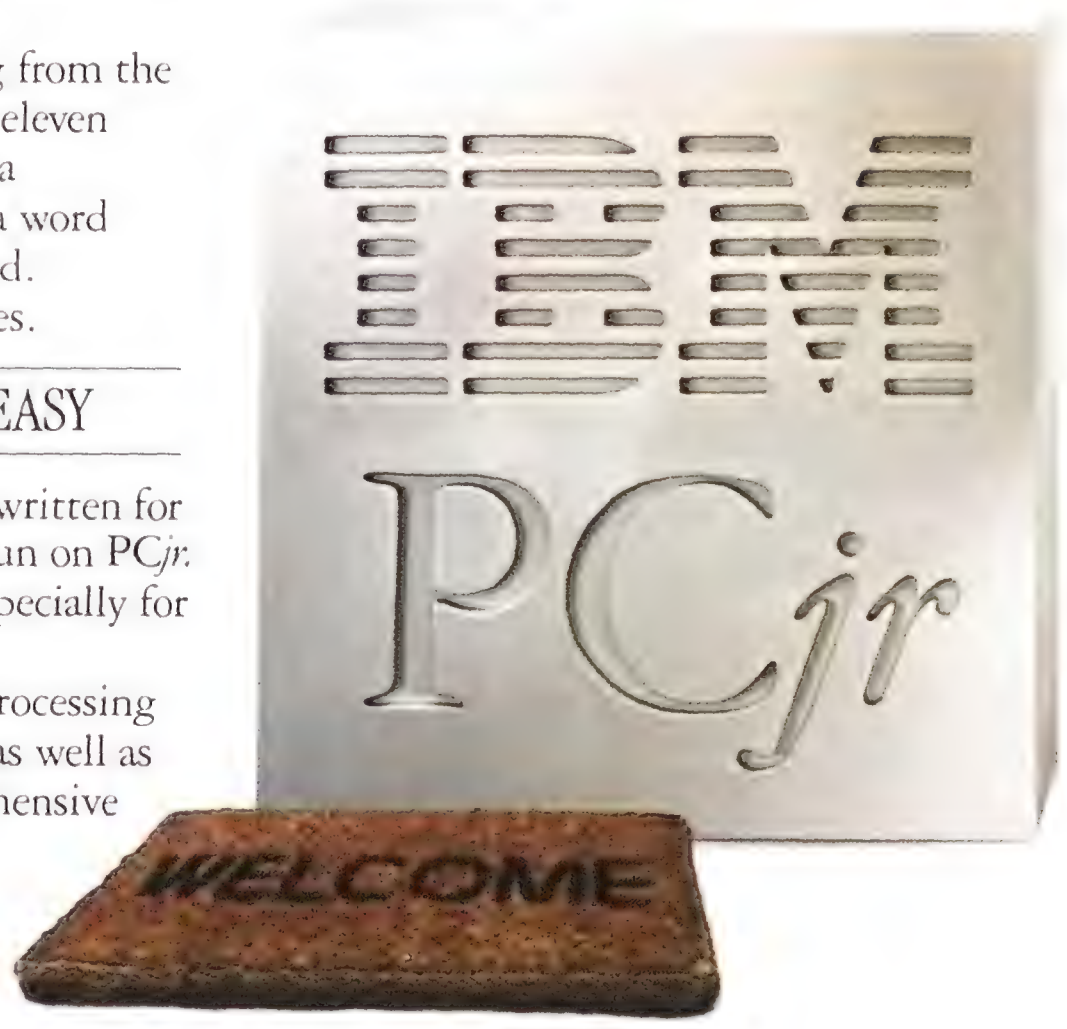

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Around the Mall and beyond

March this year inspires thoughts of the National Zoo. It's not that the place is particularly beautiful in March, but that this is the month when Ling-Ling went into heat in 1983. And Hsing-Hsing did the right thing, for once. And probably never since the reign of Louis XVI has the business of breeding, normally a private sort of occupation, been followed with such breathless interest by so many secondhand voyeurs. For the giant pandas, verging on extinction in the wild, need an heir even more desperately than did the House of Bourbon just before the French Revolution.

Last March, as everybody remembers, Hsing-Hsing finally accomplished what, for seven years, he had been unsuccessfully attempting. Like Louis, the [illegible] panda had long seemed inept. The National Zoo's panda watchers would turn away from their task with sober faces as Ling-Ling's all-too-brief estrus ended, just as, two centuries ago, the French boudoir peepers would shake their heads and shrug with Gallic despondency, night after night.

In the mornings, it is said, poor Louis would write the word *rien* in his journal. As far as I know, Hsing-Hsing did not do that, though he may have thought it.

The story of what happened last March in Panda Country was avidly reported at the time, but the full details, as told to me by Elizabeth Frank, panda collection manager, are a good deal better than *Dallas*, and I'm compelled to publish them in the faint hope of scoring a beat on those tabloids you can buy at the supermarket.

When it comes to Smithsonian pandas, the game plan at the zoo has been to start

Ling-Ling playfully nips Hsing-Hsing during one of the pair's well-publicized mating encounters at the National Zoo.

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allowing the male and female to mingle as early as October in order to get used to each other by the time Ling-Ling goes into estrus. Last year, they were first given mutual access between seven and nine in the morning, three days a week. In February, this period was increased to four days. It was scheduled to increase to five days on March 18.

On the 16th, there was an increase in the frequency of both pandas' scent marking. On the 17th, Hsing-Hsing mounted Ling-Ling. He didn't proceed to mate—in fact, he may merely have been excited by the St. Patrick's Day revelry echoing from a nearby Irish pub on Connecticut Avenue. But Elizabeth Frank said she figured Hsing-Hsing's gesture was the first positive indication that Ling-Ling had gone into heat. The periods of togetherness were immediately increased to two a day.

Friday, March 18, teemed with rain. Two panda watchers were on duty at the enclosure: Jo Anne Grumm, coordinator for behavior-watch volunteers for FONZ (Friends of the National Zoo), and Devra Kleiman, head of the Department of Zoological Research. Watch teams had been established to carefully monitor the pandas' behavior during their encounters. Also, plans had been made for artificial insemination.

In the rain, that dreary morning, the two pandas courted with great intensity. Finally, according to Elizabeth, Ling-Ling literally cornered Hsing-Hsing, backed up against him and, at about 11:45, he mounted her. This time they copulated. A cynic might say he was trapped with nowhere else to go, but never mind. Success at last! The watchers congratulated Hsing-Hsing and held a mild celebration. Later that day the two pandas were put together again and Elizabeth says their behavior was quite different from their behavior in the morning. Hsing-Hsing was more assertive, and Ling-Ling paid absolutely no attention to him.

On the evening of March 19 a team of nine, including leading veterinarians and zoologists, anesthetized Ling-Ling and artificially inseminated her. They used semen which two of their number had hand-carried from Britain. The donor was that much-publicized London panda, Chia-Chia, whose visit in April 1981 had been such a failure.

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S-3

I once watched a film of the first attempt to breed Ling-Ling artificially and can appreciate why so many humans are needed. Anesthetization is a tricky business with an animal. Ling-Ling's vital signs have to be watched carefully while she is under, and the semen has to be introduced correctly. The process didn't work with her in 1980 or 1982. It was about to be tried in 1981, after the Chia-Chia disaster, but the zoo decided against it.

Anyway, the experts went at it again in '83, all fussing over the unconscious Ling-Ling and trying not to get in each other's way. They artificially bred her on the 19th and again on the 20th, but by then they were pretty sure that her estrous cycle was ending.

Everyone knows about the birth of the baby panda and its subsequent death. Blood and tissue tests proved that it was Hsing-Hsing's cub. But because of Ling-Ling's illness last December, there is doubt at this time of writing that the zoo will try to breed her this year. The zoo experts say it depends totally upon her health. "It's entirely up to her," I was told by one of them. "If she goes into estrus and seems well, we'll give it another try."

At least Hsing-Hsing has finally established himself as a sire. It took him seven years. It took Louis XVI eight.

I dropped around to visit Ling-Ling on her sickbed and found her peacefully asleep, surrounded by tasty morsels of bamboo and nice clean water to drink. Obviously the nursing is excellent. On a bulletin board beside her quarters are pinned scores of cards: "Get well, Ling-Ling, we love you," and signed by children, sometimes a whole classroom, sometimes a whole family.

Hsing-Hsing was outdoors. It was a bitterly cold winter afternoon, but he paced around in the snow, snuffling things and sitting down for a while to munch on something. He wasn't the slightest bit concerned about Ling-Ling. I guess he isn't most of the time. Until March, or whenever it is.

The zoo is always rewarding, even on an icy afternoon. I hiked the walks, the only person on them that cold day, and was surprised to see two African crowned cranes, heads firmly implanted under their wings, standing one-legged in the

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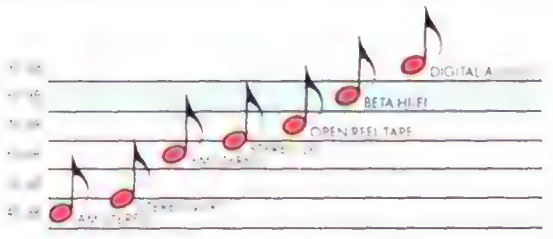

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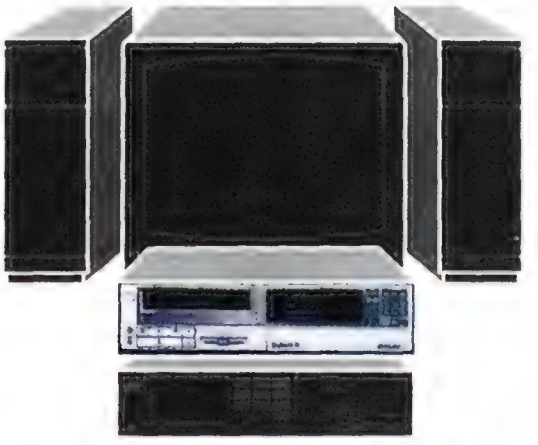

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snow like feathered shrubbery. I should think that such low temperatures would send anything from Africa straight to the central heating plant, but they seemed unconcerned. As I passed, they unstuck their heads, revealing crests and bright red markings, and looked me over with some astonishment before popping them back under those warm wings.

The lions, who often play and roar delightfully on cold days, disappointed me. Perhaps they found life on Lion and Tiger Hill just too grim that afternoon (I certainly did). Anyway, they were out of sight. But under the hill is a display of golden lion tamarins, the tiny, Day-Glo orange monkeys with long hair which forms miniature lions' manes around their faces. They're natives of the rain forests of coastal Brazil, which, as you know, are being hacked down at a disastrous rate. That's why golden lion tamarins are on the brink of extinction in the wild. Estimates put their wild population at perhaps 150.

Breeding is a tricky problem for these little fellows, just as it is with pandas.

Nikumba, a male gorilla, and one of his "harem"—Femelle—at Great Ape House.

Zoos could scarcely claim any success until Devra Kleiman, again, led a National Zoo project, begun some ten years ago, to find out why. It turned out that the tamarins are monogamous, have complicated rules for raising youngsters and do best in small family groupings based around one breeding pair.

With this knowledge and the proper diet and housing, Kleiman's people got them to breed in captivity—more than 200 of them have been born at our zoo alone since the beginning of her research. Now the zoo is involved in a project to ship tamarins from several zoos, including ours, back to Brazil, where the government some years ago set up a forest reserve. If the plan goes through, the animals, after a period of acclimatization and a cram course in foraging and dodging predators, will, the zoo people hope, breed successfully in the wild.

I dropped in at the Great Ape House, a showplace if ever there was one, and saw some old gorilla friends. Nikumba (left) was half-reclining under a color TV set on which I recognized *Days of Our Lives* (I'm working at home a lot, these days, and have been following it). Nikki, as he is called, wasn't watching the picture, however. And although he seemed fascinated by all the sighs and heavy breathing on the sound track, I'm assured that he was not paying attention to that, either. Apparently his position gave him a peek at the kitchen area, hidden

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from the public, where the gorillas' afternoon meal was being prepared.

Two females, M'wasi and Femelle, were right beside Nikki, and Sylvia wasn't far off. The zoo has been grouping the gorillas this way, three females to one male, to approximate more closely their social structure in the wild. The hope is that this will increase their chances of breeding successfully in captivity. So far, the animals seem happy with the arrangement. Nikki is probably happy because so far he's the chosen male for this particular experiment.

Sylvia holds back a bit in the *ménage à quatre*. She tends to be a loner. The reason is that she was reared by humans and acquired one of the many ills that human flesh is heir to—an identity crisis. She finds it hard to believe that she is really a gorilla.

But she is, all right, as the others make clear to her, and on her good days she joins with them in foraging in the hay for treats and sharing the endless entertainment of staring at people. The zoo hopes that the experience from this grouping will improve the chances for the gorillas' propagation in captivity. It's now up to nature to take its course.

Edwards Park

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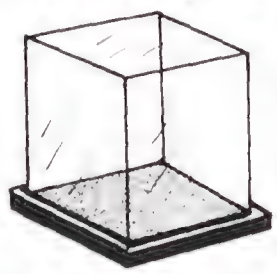

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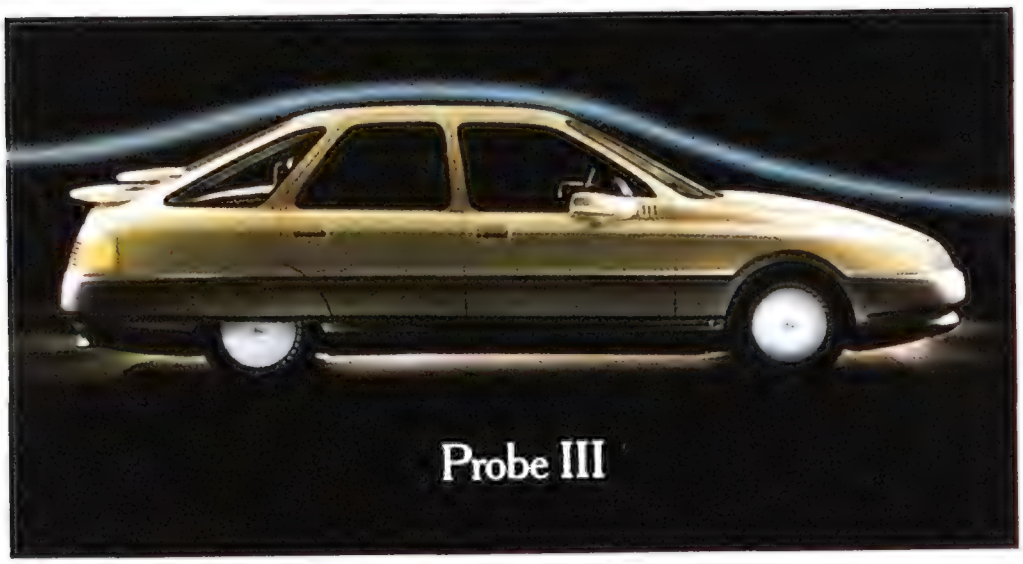

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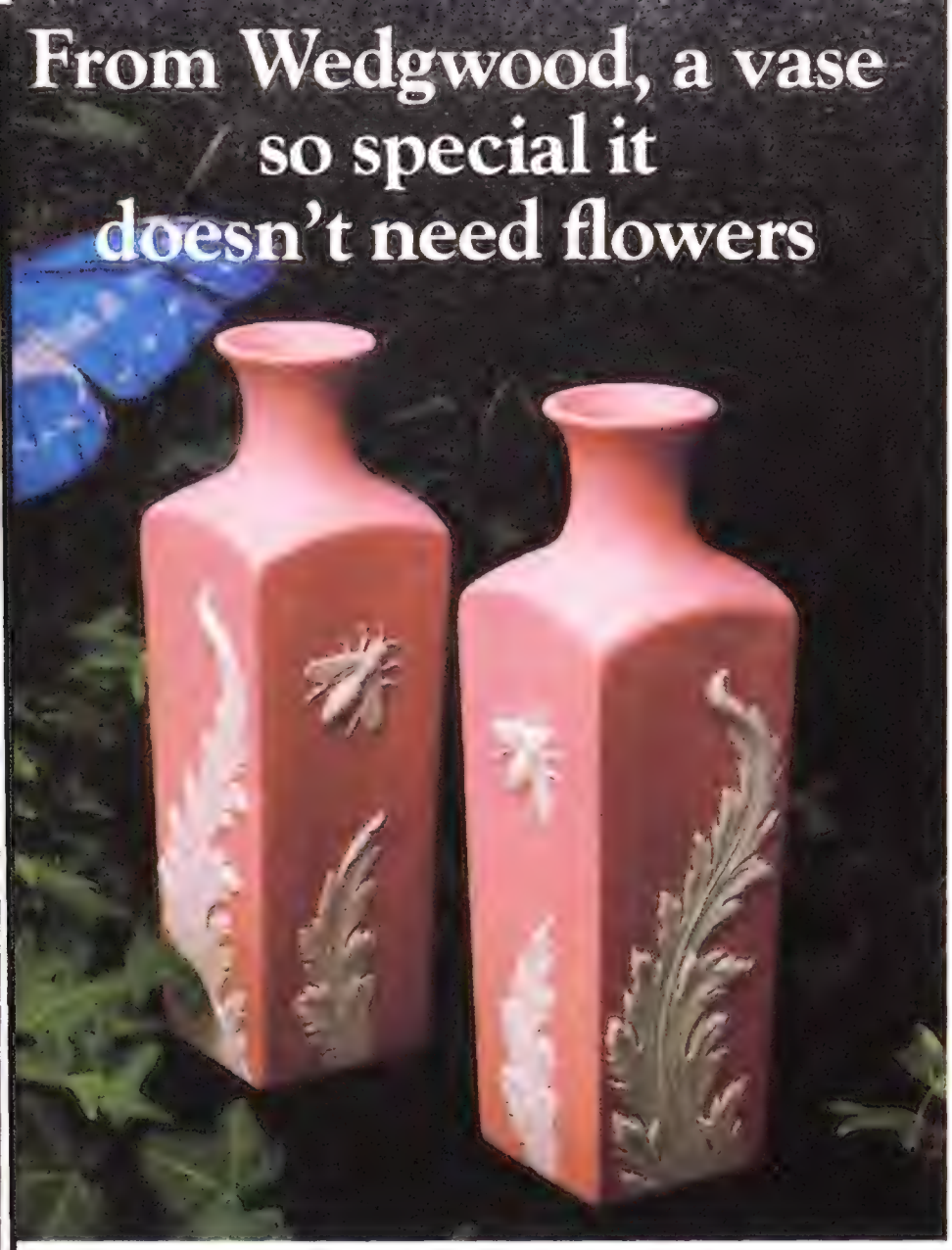

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Phenomena, comment and notes

Confining himself to uncommonly clear prose, a mathematician explains what the purest science is all about, and what it says about reality

Sometimes when I'm sitting in the woods, I wonder what a real naturalist would see from the same spot. Or an Indian would have seen. I wonder if a dog's perception of that particular place would bear any resemblance to mine.

Looking at the stars or a rock in my hand, I wonder what physicists see when they look at the world. Do they sense the empty space in matter, the electric fields? Does an astronomer look up and see the synchrotron radiation of electrons spiraling in magnetic fields, or the fierce X radiation thrown off by matter as it disappears in the maw of a black hole?

We humans are able to see much more with our minds than we can with our eyes. We transcended our physical limits a long time ago, and there are no discernible limits to how far we can go. We do it with imagination, our power of "forming a mental image of something not present to the senses or never before wholly perceived in reality." I see bushes and birds, and struggle just to identify them. An ecologist sees food webs and carbon cycles. I see points of light in the sky; an astronomer sees nucleosynthesis and plasma convection.

The purest power of imagination, however, may be that exercised by mathematicians. Their constructions begin entirely within the mind, although, I have just discovered, their most abstract and counterintuitive results have an uncanny way of turning up in the real world decades later. How is it that the most bizarre imagining a mathematician can achieve not only can, but almost always does, turn up?

These thoughts are the result of reading *Bridges to Infinity*, a collection of essays subtitled *The Human Side of Mathematics*, by Michael Guillen, a mathematical physicist at Cornell University. It took me a while to pick it up; after all, I have made a career of skipping the pages of equations in scientific papers and moving right to the results and conclusions. (Journals of ecology are as forbidding these days as journals of astrophysics—it takes more bravado all the time to maintain illiteracy.) I once spent a year at a magazine where part of my job was to "spec" equations:

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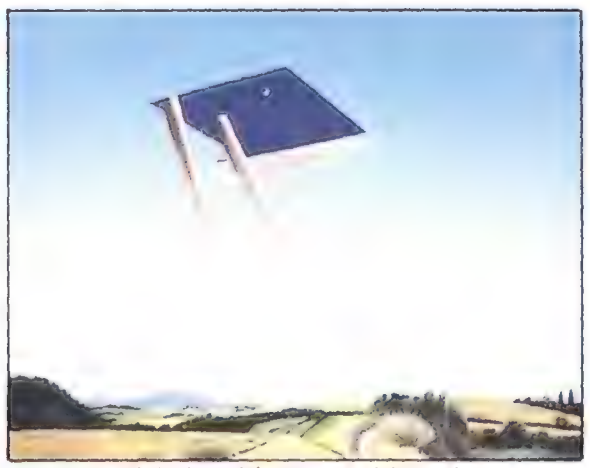

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mark for the printer which letters or numbers should be printed in italic, which in boldface and so on, even though I hadn't a clue as to what the equation said. Twice I took calculus, and if someday you notice a man mumbling to himself as he walks down the street, don't be harsh: he may have been one of those two ill-fated instructors.

Guillen knows just how to approach mathematical illiterates: he has written a whole book about mathematics without a single equation. And he succeeds. He not only explains what it is that pure mathematicians do today, what they are working toward and what they worry about; he also makes clear how mathematics has evolved from a science of certainty to one in which only uncertainty is certain, how mathematicians have had to make room for faith in their world of rigorous proofs. At the same time, he looks at enough mathematical flights of fancy that have later appeared in the real world to conclude that the mathematical imagination is a sixth sense, one we need as much as the other five.

Early on he equates (if you'll forgive the pun) the infinities mathematicians routinely consider with the apparently limitless possibilities of the human mind. In an essay on calculus, he introduces the idea of an asymptotic limit. An asymptote is an infinitely long line that a curve can approach but never actually meet, "like an airplane that approaches a runway but never actually touches down." It is a way to approach infinity. As an easy example, Guillen offers the numerical sequence .9, .99, .999, .9999, and so on. The asymptotic limit is the number 1, even though the sequence, while getting closer at each step, will never actually get there.

Runners once thought of the four-minute mile as an asymptotic limit, something they could approach more and more closely but never achieve. Roger Bannister changed all that 30 years ago. There probably is an asymptotic limit to how fast a human being can run a mile, but we will not be able to estimate it until new records improve on the old by consistently decreasing amounts. There may be asymptotic limits to all our human goals, personal and social, Guillen concludes, but we are not even close to a calculus that can reveal them. And even if they exist, they won't get in our way

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any time soon: "The chief paradoxical characteristic of any approach toward an asymptotic limit is that the future promises to be an interminable sequence of improvements. . . ."

An essay on infinities themselves is worth at least two aspirin, even though the prose is straightforward. It seems clear enough that the positive whole numbers (1, 2, 3, and so on) form an infinite set: there is no last number. The same is true of just the positive even numbers (2, 4, 6, and so on). So is the infinity of all whole numbers twice as large as that of even numbers? Apparently not. As Guillen explains it, the German mathematician Georg Cantor approached such questions with the notion of equivalence. Two sets are equivalent in size if the elements in one set can be paired with the elements of the other. If everyone who enters a stadium, Guillen explains, finds a seat, so that no one is left standing and no empty seats remain, then the number of seats and the number of people are equivalent. You do not have to know how many seats or people there are to be able to make the statement.

Well, the even numbers in their infinite set can be paired off with those in the infinite set of all the whole numbers: 1 with 2, 2 with 4, 3 with 6, and so on. Cantor could not enumerate each pair, of course, but he did argue that it is "inconceivable how such a pairing could possibly leave an excess of either kind of number, since each set of numbers was inexhaustible."

Essays take us through the time when the seemingly solid world of mathematics shattered under the impact of imagination. Mathematicians like Nikolaus Lobachevski and Bernhard Riemann developed geometries that were very different from Euclid's, until then a cornerstone of human thought, and just as logical. (Einstein would later show that the universe's geometry is not Euclidean—although astrophysicists are not yet sure whether it is Riemann's or Lobachevski's geometry that best describes the large-scale universe—thus setting the stage for the discovery that reality does "imitate" mathematics.) And Guillen lets us feel the impact of Kurt Gödel's 1931 proof that there will always be mathematical truths that cannot be proved with logic.

The later essays bring us up to the

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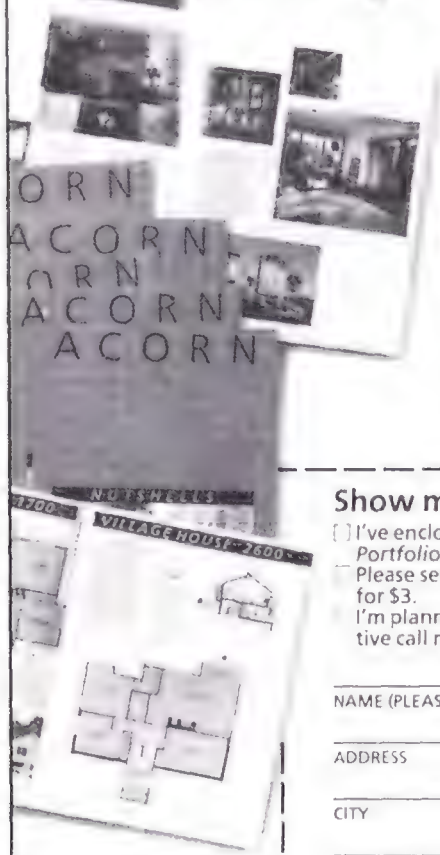

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present, in which mathematicians wrestle with techniques not yet ready to apply to human endeavors and with problems they already know they can never perfectly solve. One of the first is catastrophe theory (the word catastrophe here means only abrupt change, but can include events we would normally consider catastrophic, such as death). Catastrophes are analyzed for the number of controlling factors involved, and visualized as geometrical shapes. An irreversible event like death is described as falling off a line at the place where it curves downward: you can't get back on. But in the aftermath of many abrupt changes, recovery is possible. Mathematicians envision these as falling off one part of a curved surface onto another; you can climb back up again to where you were.

Two essays on game theory, which Guillen defines as the mathematical study of rational conflict, eased my suspicion that somewhere somebody is writing down the equations for human behavior. It turns out that game theory assumes perfect conditions, such as that the players are ideally matched and always deliberate all their options. That would seem to separate theory nicely from the messier world most of us live in most of the time.

I should not have been worried. In an earlier essay on the geometry of space, Guillen had said that a human being can be thought of as having an "extraordinary number of dimensions—some might even say an infinite number. . . . So pity the social scientists," he continued. "One of the reasons that their track record looks so miserable compared to that of the physical scientists is simply because their job is more difficult, and perhaps even impossible."

Presumably, mathematicians will continue to test the results of their imaginings against the reality of human society. At the same time, they are learning to live with the idea that they will never find the perfect answer to some kinds of problems. A classic is the traveling salesman problem. If he is to visit 50 cities, what itinerary will let him travel the least distance? Guillen says there are ten thousand million million possible itineraries and the best we can do, even with the biggest and fastest computers at our disposal, is come within 20 percent of the perfect answer. We can work out a route that will

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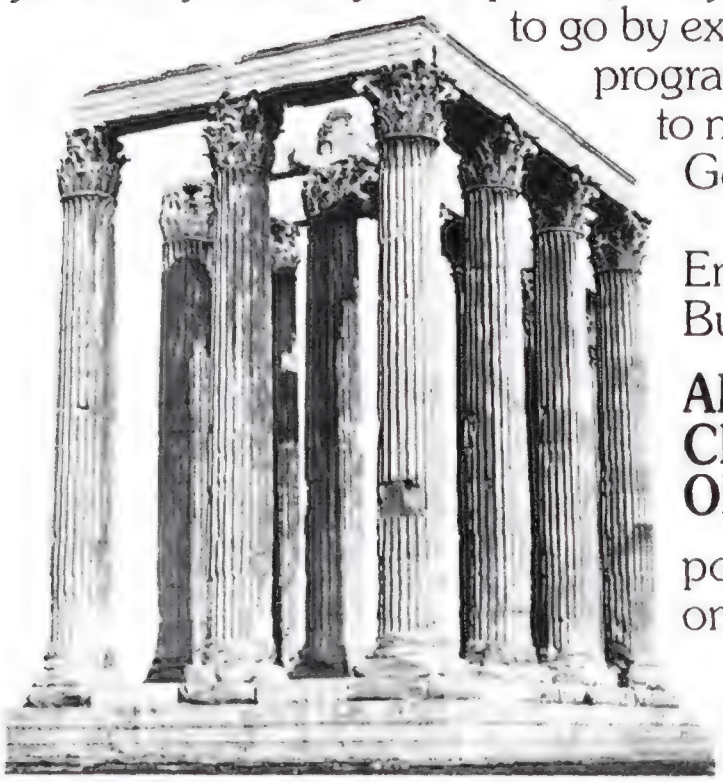

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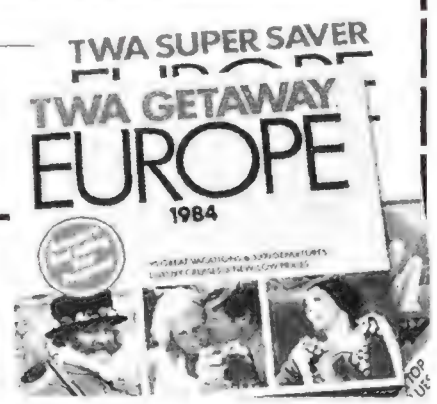

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add no more than 20 extra miles to every 100 a perfect route would have him travel.

Guillen calls this optimizing. He has divided the book into three sections. The first is called fantasizing, and covers the period when mathematicians thought perfection was possible, a period that ended only in the last century. The middle section is called compromising, and tells of their discovery that logical perfection is not attainable. And the last is optimizing, making the best of what we find is possible.

Making the best of it, in this case, is no defeat. It is pressing ahead toward an asymptotic limit. And as mathematicians continue to throw their imaginations out ahead of us, they will continue to bring back new ways to understand the "real" world. As Guillen says:

"It doesn't appear that we are merely inventing ideas that just happen to describe sensible objects; it seems, rather, that the mathematical imagination is an extra sense with which we can perceive the natural world. And it is an extremely efficacious sense, because it often perceives reality long before our scientific senses do. If thought of in this way, the coincidence between the natural world and the mathematical world is not any more mysterious than the coincidences between the natural world and the auditory, tactile and olfactory worlds. . . .

"If this mathematical sixth sense does exist, then certainly modern biologists would have us know that it probably evolved, like all the animal senses, in order to enhance our survivability as a species. . . . If the mathematical imagination is our sixth sense, therefore, the traditional, abstract and super abstract numbers of algebra are not merely algebraists' playthings; they are, by dint of helping us to perceive the world around us more accurately, instruments of our survival."

It is too late for me to learn the language. It was years ago that my children started explaining algebra to me instead of the other way around—and gave up. The Michael Guillens of the world are my only hope. He runs the risk of disapproval by his peers: the British mathematician G. H. Hardy, he writes, felt that explaining math to the rest of us is "an activity for second-rate minds." Guillen's isn't, and I hope he keeps it up.

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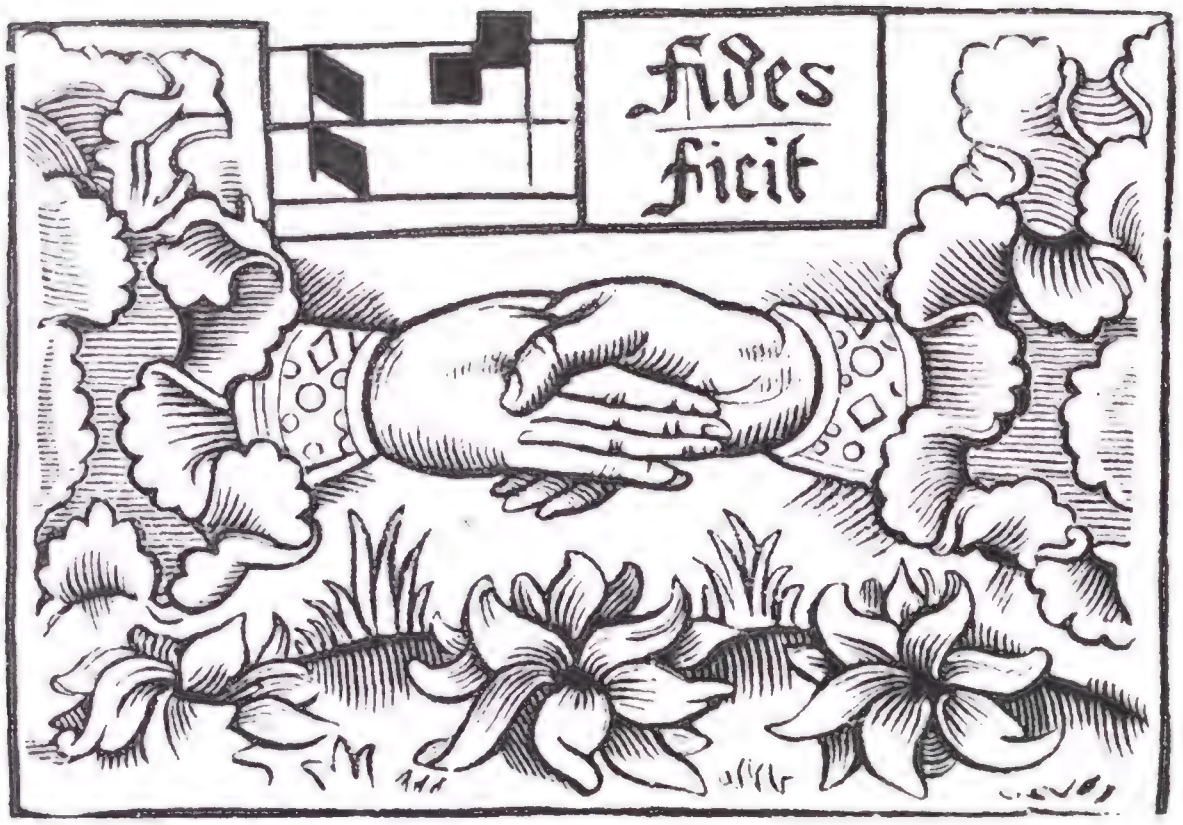

Visual pun of 15th century combines the musical scale ("so, la") with Latin words and clasped hands to mean *Sola fides sufficit*, faith alone suffices.

Hidden in every handshake is a long and magical history of hands that belonged to kings, thieves, corpses

In 1792, the celebrated English eccentric Captain Philip Thicknesse passed on, but not before leaving one of the world's most unusual wills. He stipulated that his right hand should be cut off and delivered to his inattentive son, Lord Audley. The rebuke was, as the will said, intended to "remind him of his duty to God, after having so long abandoned the duty he owed to a father, who once so affectionately loved him."

Thicknesse had some reason for doing so, because the hand has forever been a symbol of friendship and duty—as the recreant Lord Audley was doubtless to find out.

Consider the handshake, for example. Traditionally, this ritual is thought to be a sign of peace and goodwill. After all, we do it with the right hand—the *weaponless* right hand—as if to say that we welcome another's friendship and guarantee not to wield force against him or her, at least for the nonce.

Actually, the handshake has been much on my mind recently, ever since I recovered from a mild bout with scarlet fever, a flu-like illness that reddens the skin on the palms of your hands. Later, that skin flakes off as it would after a bad sunburn. For weeks, I shrank from shaking hands with strangers.

That's exactly the point about handshakes. Far from being merely a negative expression ("I won't hurt you, for I have no weapon"), the act is instead positively friendly ("I gladly take your hand, heedless of any illness you may have, for I *trust* you").

Truly, the handshake is an ancient and honorable custom. In its oldest examples it had to do with the conferring of power from God to Man. In Babylonia, it was customary for the king to grasp the hands of a statue of Marduk, that civilization's chief god. This act, which took place annually during the New Year's festival, served to transfer authority to the potentate for another year. So persuasive was the ceremony that when the Assyrians defeated and occupied Babylonia, the new kings also felt themselves compelled to submit to the ritual.

It is a king's job to pass a sense of divinely acquired security on to his people. The idea is embedded in the Old English legal custom of "hand-grith," under which the monarch's protection of his subjects was guaranteed "under the king's hand." Similarly, on medieval feudal estates, it was the custom for tenants swearing fealty to a new lord to have both their hands clasped tightly between those of their new master during the ceremony. But there might have been more to this custom than a mere transference of power. In 1775, an early folklorist speculated that the reason for this was to prevent the lord from being murdered during the investiture, and that this horror had happened at some time in the past.

Perhaps the greatest of miraculous handshakes occurs in the legend associated with Wilfreda, a British saint who lived in the tenth century. It is reported that her beauty so enflamed King Edgar (944-975) that he pursued her vigorously, even to the door of a church. When the king caught up with her, he dropped to one knee, took her hand and plighted his troth. Evidently Wilfreda thought little of the idea—so little in fact that she retired directly into the church, leaving only her hand in his royal grasp. Legend has it that Edgar was so undone by this miraculous occurrence that he immediately gave up his pursuit.

In classical literature, clasped hands were not only a symbol of power, they could also be a formidable obstacle to other forces, even natural ones. Ovid related how the mother of Hercules, Alcmena, was forced to travail in childbirth for seven days because her enemies sat before her house with clasped hands. Pliny the Elder also warned against interlacing your fingers anywhere near a pregnant woman or a sick man who is being given medicine.

Among the most primitive peoples, the hand was associated with powerful taboos. The Polynesian Maoris ostracized a person who had handled a corpse. Mourning widows or widowers among the Shuswap of British Columbia were further forbidden to touch their own bodies until a certain time had elapsed. Warriors of the

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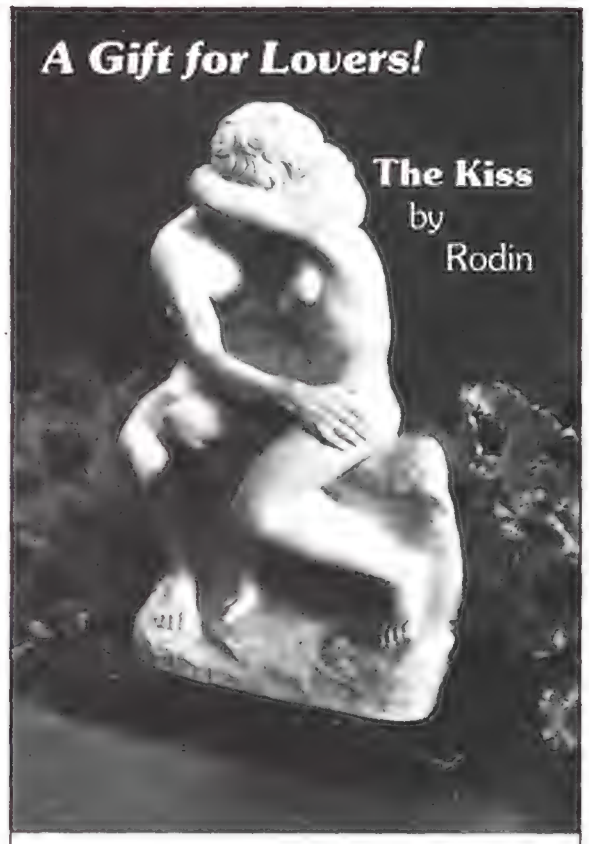

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Theddora tribe of southeast Australia and the Dyaks of Sarawak used to eat the palms of their enemies.

To prevent the ghost of a suicide from haunting, the ancient Athenians used to cut off the hand and bury it apart from the body. And when the Kurnai of Australia saw the Southern Lights in the sky, they would swing a dead man's severed hand at it, intoning "Send it away! Do not let it burn us up!"

But there are more relaxed uses of the symbolic hand as well. Among the Bering Sea Eskimos, a very special hand is depicted on masks, utensils and other items. This is the hand with a hole in its palm (SMITHSONIAN, May 1982). The hole is a reminder that at least some game should be allowed to escape from the hunt, so that they may propagate an eternal supply of food.

Since kings' hands have always held special taboos, it is fitting that they should have special powers as well. In England it was commonly held, well into the 18th century, that the disease of scrofula, or the King's Evil, as the illness was also called, could be cured by a royal touch. Dr. Johnson, the great critic and scholar, was thus touched as a very young child by Queen Anne as she made one of her regal passages through London. Later, when Boswell asked one of the greatest intellects of his day if he remembered the occasion, Johnson replied that he had "a confused, but somehow a sort of solemn recollection of a lady in diamonds, and a long black hood."

During his reign Charles I cured 100 patients on a visit to Scotland and Charles II touched nearly 100,000 cases during his tenure. History is silent on his cure rate. William of Orange, however, scoffed at the practice. Once, when he deigned to touch a pleading sufferer, he added: "God give you better health and more sense."

Curiously, the other marvelous touch is held not by royalty, but by hanged men. Folklorists call this the "hand of glory" and its powers are legion. Nursing mothers would willingly bring their babes to the gallows to have the executioner stroke their infants with the hands of executed criminals.

The hand of glory was also an important part of the burglar's kit. A French text of 1751 says that the hanged man's hand could stupefy every sleeper in a house so that intruders might go about

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their underhanded work undisturbed.

Children worldwide seem to have arcane uses for handshakes. As Iona and Peter Opie observed in *The Lore and Language of Schoolchildren*, youngsters cement bargains and reunite friendships by shaking hands and having a third child break the grasp with a blow. In Glasgow, the third party says "Cut cheese" as he or she does so.

A similar handshake may occur when children randomly say the same phrase at once. In Austria, for example, they join pinkies and shake their linked fingers three times. In Italy, they count to three and then let go, crying out either "Flic" or "Floc." If again they say the same thing, each is allowed a free wish.

The hand is also implied in one of the oldest games on record, a clenched-fist game in which the players try to guess how many fingers an opponent will show. The game is called morra, and was played by both the Egyptians and Romans. An English manuscript of 1341 depicts a game under way.

Closer to our era, fur trader Henry A. Boller reported that he often noticed "the game of hand" being played by the Assiniboines, an offshoot of the Sioux nation, along the upper Missouri in the late 1850s. In a first-hand account of his travels, Boller noted that the game seemed so engrossing that the braves would rather do that than eat, chanting "heh-ah-heh" as they gambled. The game also figures in a famous bon mot: "An honest man," said Cicero, "is one who would play morra in the dark."

With all this weight of history and tradition associated with hands and handshakes down through the ages, it is easy to see how the greatest of artists would want to grab hold. So it was with Shakespeare. In *Julius Caesar* he uses the hands to the hilt, literally. The scene is immediately following the grisly murder in the Capitol. Brutus enjoins his fellow conspirators to "bathe . . . hands in Caesar's blood/Up to the elbows." Then Mark Antony enters. Says he: "Let each man render me his bloody hand;/First, Marcus Brutus, will I shake with you." The violation of the handshake trust is so palpable here you can almost feel its power. But trust is wasted on such killers, Shakespeare is telling us. What's needed now is simple justice.

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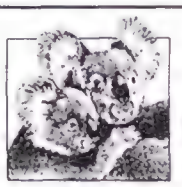

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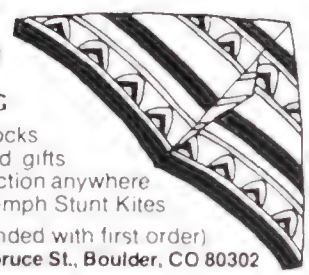

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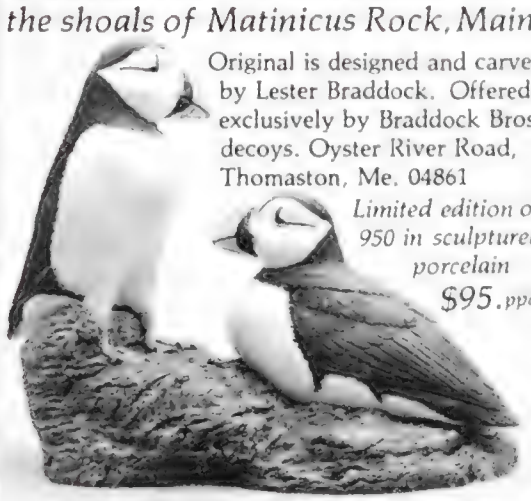

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By James R. Chiles

Engineers versus the eons, or How long will our monuments last?

Even if we abandon them, giant structures might endure as long as the Seven Wonders; one may even make it to the next Ice Age

The World Trade Center towers in Lower Manhattan are among the most ambitious structures of our age.

If all goes according to plan, one day in 6939 a crowd will gather in New York City's Flushing Meadow. Workers—probably a squad of robots—will bore 50 feet into the soil. They will haul up a copper cylinder containing ten million words and 1,000 pictures on microfilm: parcel post to the future from the World's Fair of 1939.

Americans didn't invent the time capsule. Sumerians and Egyptians put inscriptions and mementos in the foundation deposits of important buildings. Something in human nature hopes we're not just chalk marks on the blackboard of eternity.

One way we reach for influence beyond our life span is with our buildings, particularly our monumental structures. Most crumble in a geologic instant. Of the Seven Wonders of the World, six are no longer with us. At least two fell to earthquakes (one just 55 years after it was built), and one to war. We are not sure what happened to several others, and there is doubt that one ever existed. The best of the six lasted about 1,500 years. The seventh wonder, and also the oldest, is still with us: the 4,500-year-old pyramids at Giza.

Some modern wonders are already suffering. Acid rain is burning through the Statue of Liberty's torch and copper gown. Weather, road salt and the pounding of trucks crumble the concrete decks of our bridges. Constantly we repair, we replace, we restore.

How would some of America's grandest structures measure up if we all packed our bags and left? The question is not as far-fetched as it sounds: if any structure stands long enough, odds are good that the parent culture will abandon it to the erosion of earthquakes, fire, weather and war. The pyramids, Stonehenge, the Great Sphinx, Machu Picchu, Mesa Verde: all of these have been untended most of their lives. Their declines are measured in hundreds and even thousands of years.

My aim is to predict the independent life of three modern structures, entirely apart from human hands that can help or hurt. The structures: the twin towers of the World Trade Center of New York City (above), the tallest skyscrapers in the world save one; the Gateway Arch of St. Louis, the nation's highest monument

Once abandoned, towers would eventually succumb to rusting-through of the steel-column supports. Here, one tower has already fallen victim to a hypothetical hurricane; the other one will follow before too long.

Illustrations by Paul M. Breeden

Water in basement would induce fatal rusting in steelwork that holds up a Trade Center tower.

(p. 60); and the Grand Coulee Dam of Washington State, the largest concrete structure on Earth (p. 64).

I peered off roofs, pored over plans and poked at rust. I went to the structural engineers, maintenance men and geologists, and asked: "What if we abandoned this thing? What is the sequence of events?"

The World Trade Center towers are easy to describe (SMITHSONIAN, January 1978). They loom over the Hudson River, on the southern end of Manhattan Island. At the top, 1,350 feet and 110 stories up, the towers are the same width as at the base, still square in plan, each floor nearly an acre in area.

Saving the towers from blockishness is a fine lattice of columns that reach from plaza to thick concrete roof. Tall, narrow windows peek out between them.

Doing stonework for a house in Missouri started author thinking about the life of structures. Trained for the law, he is now a free-lance writer.

From a distance the columns appear delicate, but they are the towers' strength against winds. Wide welded-steel plates, called spandrel beams, connect the columns horizontally at every floor and help stiffen them. Aluminum covers protect columns and spandrel beams from weather.

Something has to hold the floors up. In the Trade Center towers, the external steel walls share the load with a separate set of steel columns in the core of each building. Together, the core columns and external wall columns pass the 280 thousand tons of each building 68 feet down through the basement to bedrock schist.

How might such a building die if everyone walked off? Les Robertson of New York had some speculations.

Robertson is the structural engineer who designed the steel-and-concrete frame of the World Trade Center towers. His firm used tables and charts, wind-tunnel tests and computers to put a skeleton into architect Minoru Yamasaki's vision. Lean and silver-haired, seated in his conference room, Robertson cast his mind forward into the future and imagined how his greatest work might die.

Almost surely within a hundred years, perhaps as soon as 20 years, the basements would fill with salty water (left) from the Hudson River after heat-exchanger supply pipes or one of the PATH transit tubes rusted through. This is very important. As Robertson said, "Filling of the basements would be the biggest single danger to the Trade Center." The reason is rust. But nothing major happens for several centuries, so we'll return to the rust later.

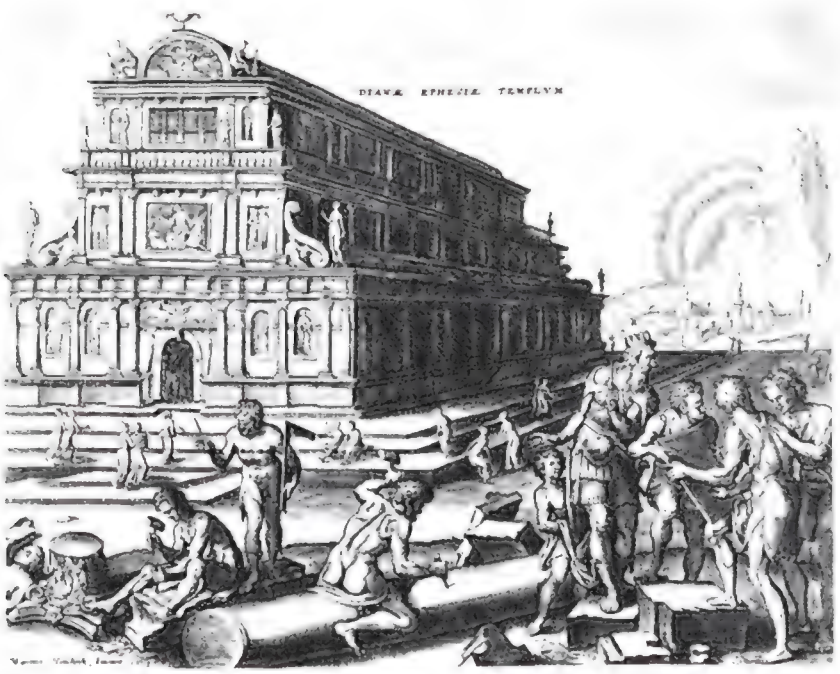
What of the windows? Even the best-behaved buildings lose a few windows now and then. Winds stir up gravel from adjacent roofs and nick the glass, which eventually fractures and later breaks out. Once this process starts, it is self-reinforcing. Wind plays through the floors and breaks out more windows. Over centuries, gasketing would embrittle under the influence of sun and heat. High winds would pop the glass out.

Buildings last longer without windows

Oddly, said Robertson, "as the glass strips out of the buildings, the buildings themselves become more resistant to the wind," the ultimate destructive force. Empty windows diminish the wind's impact.

The loss of glass would help, but it could not keep the towers up forever if important supports in the basement were being eaten by rust. Rust is nature's way of returning steel to iron ore by combining it with oxygen. Oxygen is richest at the tidal zone, where water rises and falls daily. The basement of the Trade Center would have a tidal zone, because the broken pipes or tubes would admit and discharge water from the tidal Hudson River.

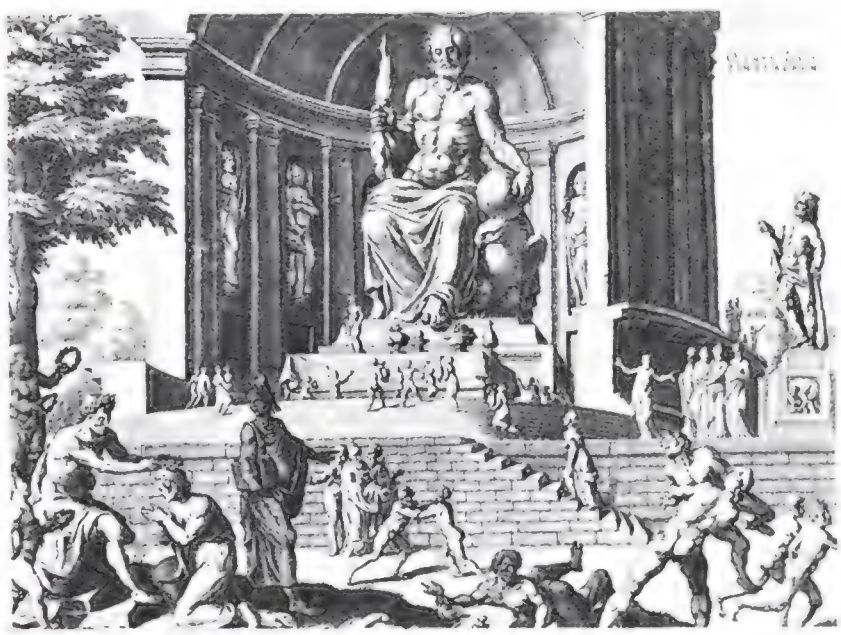
Six ancient wonders that did not survive



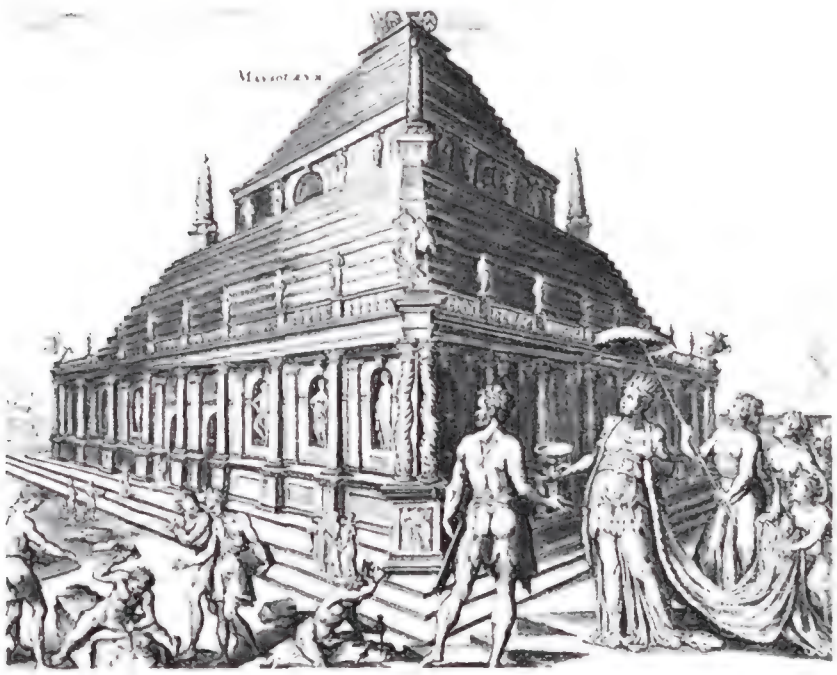
King Croesus built the Temple of Artemis at Ephesus about 550 B.C. Invading Goths destroyed it in A.D. 262.

Built about 280 B.C., the lighthouse on Pharos stood at least until the 12th century; its fate is unknown.

The Colossus of Rhodes broke off at the knees in an earthquake about 225 B.C., 55 years after completion.



Phidias of Athens completed this 30-foot statue of Zeus about 430 B.C.; temple was destroyed in A.D. 426.



Tomb of Mausolus, begun in 353 B.C., probably was destroyed by quake between 11th and 15th centuries.

Nebuchadnezzar's Hanging (more likely rooftop or terraced) Gardens of Babylon may be apocryphal.

How long might our monuments last?

The soaring Gateway Arch in St. Louis could, if abandoned, someday be toppled by strong winds.

In the basements are three types of structural steel: the core columns under the central areas of the buildings, the bases of the external wall columns, and diagonal braces. In cross-section all are hollow boxes of structural steel, with walls about three to eight inches thick.

In a strong enough wind, the rusted and separated structural steel in the basement might fail in one of several ways, causing the rest of the building to fall over. The diagonal bracing could collapse, or the external wall columns on the basement's downwind side could buckle under the compression that high winds cause. Or, less likely, the upwind external wall could rip apart under tension. "Failure mechanisms are very complex," Robertson cautioned. He said he has no firm idea how long failure might take, but doubted that the towers would stand much beyond a thousand years if abandoned. He thought a hurricane might finish off the abandoned towers.

Picture how the fall might happen: hurricane winds push at the gap-toothed building with the force of 15,000 tons or more. In the basement a few rusty columns bend; other columns take the load, but it's too much to bear. More buckle and the building shudders like a notched tree. Moving very slowly, it leans a little more downwind; concrete explodes off other columns in the basement. Moss-covered furniture in the lobby slides as the ground floor dips. Pigeons and owls flutter out of broken windows into the hurricane and are swept away.

Skyscraper and tenants crash to the ground

Shortly after the tower begins to fall downwind, it also starts collapsing into the basement. A sound like gunfire rattles the air as bolts connecting the steel wall panels shear off. Most of the remaining windows shatter. Concrete floor panels rumble as they crack in a hundred places. A screeching builds in a crescendo, louder than the howling of the hurricane wind, as hundreds of steel columns and spandrel beams tear in half. The tower is picking up speed now, 500 feet off the vertical, leaving an arc of debris across the air. Cats, rats, cockroaches—all tenants go into free fall. Skyscraper greets ground with a mighty roar and the Trade Center tower is no more. Not much later, the second tower would fall. End of scenario.

Wind would also be an accomplice in the death of the Gateway Arch, but the modus operandi is considerably different. The 18-year-old arch is a breathtakingly slender structure, soaring 630 shiny feet from a bluff located between St. Louis and the Mississippi River. Federal and city money built it to celebrate the city's role in the settlement of the West.

In cross-section the Gateway Arch is an equilateral

triangle with 54-foot sides at the base and 17-foot sides at the top. It has two skins spaced a short distance apart. The outer skin is butt-welded stainless-steel plates. The inner is carbon steel. Short steel rods span the space between the two skins. The arch is stiffened by a concrete filling between the skins from ground level up to the 300-foot mark.

Anchored in each base's 13,000-ton concrete foundation are hundreds of long steel post-tensioning strands that reach up to grasp the concrete in the legs. Some strands extend to the top of the concrete.

"No metal used is free from corrosion"

The arch's stainless-steel skin is steel with nickel and chromium added to the melt during its manufacture, which significantly increase its durability and hardness. In the presence of water, however, "no metal used in building structures is entirely free from corrosion," said Geoffrey Frohnsdorff, chief of the Building Materials Division of the National Bureau of Standards. In fact, even new stainless steel is protected by a thin, transparent film of oxide similar to rust. But over long periods the busy fingers of water and abrasion by airborne dust rub this oxide off and more stainless steel reacts to take its place.

If the arch were abandoned to the weather, little would happen for many years. Tibor Szegezdy, who is managing partner of the firm that was the arch's structural engineer, thinks that a structure of this size and significance should be periodically surveyed. Szegezdy said that eventually the corrosive combination of water and dissolved acids would etch small openings in the stainless-steel exterior. These would permit water to get under the arch's skin (right).

Water would run down to accumulate on and deteriorate the top of the concrete filling, 300 feet above the ground. It would also rust the steel stiffeners between the skins there, and the inner carbon-steel skin. Szegezdy thinks that a weakness would develop at the 300-foot level, as cracks appeared in the steel skins.

What would fell the arch? One of North America's strongest earthquakes, called the New Madrid after one of the Missouri towns it shook down, occurred 172 years ago. The active zone reaches to 150 miles south of the arch. It spawns big quakes every 650 to 700 years. And earthquakes, said Szegezdy, would be similar to high winds in their effect on the arch. Would a quake do the job?

Not likely, Szegezdy said. "The wind loads are of much greater concern than earthquake loads here, because the area is known for high winds and the probability of an earthquake is relatively low. The arch, because it is tall and slender, is more susceptible to wind." Indeed, a tornado passed within a mile of the present site of the arch in 1874. Szegezdy guessed the arch, if not maintained, would stand "considerably less than a thousand years."

Rust and corrosion would eventually penetrate skin of arch, especially where the interior concrete ends.

A scenario: one summer day hundreds of years from now, warm winds rise to wave branches on the trees growing on crumbled buildings of downtown St. Louis. The arch, shiny but spotted in places, stands temporarily triumphant over the leafy skeletons of masonry. To the southwest, greenish-black clouds gather. A funnel forms, touches the ground to take on a dirty tint and vacuums a sinuous path toward the arch. The top of the arch starts swaying in a nervous ellipse. The tornado passes 500 feet to the west and 120-mph winds shove on the steel sides. The top half of the arch leans a bit too far and folds over at those rusty cracks to collapse on the ground. As the tornado roars off for smaller prey, the two concrete-stiffened arms jut 300 feet into the air, as if reaching for their missing link (p. 62). The pillars might stand for another 5,000 years.

High winds, perhaps from a passing tornado, could snap Gateway Arch apart at critical 300-foot level.

That's a long time, but Grand Coulee Dam on the Columbia River would be around even longer. This monolith of eastern Washington State has the durability that only 24 million tons of concrete can give. Major parts would survive until the next Ice Age. Glaciers would destroy it, but not in the way you might expect.

Properly designed, dams are durable. A 20-foot-high stone dam on Syria's Orontes River is more than 3,200 years old. By comparison, Grand Coulee is but a toddler; it first started lighting bulbs in 1941.

The dam once ran straight as a string across the valley. There's been some work since then, and now it takes several doglegs. Starting from the west side, it emerges from the granite valley walls, runs about 4,000 feet straight across, turns downstream for about 1,000 feet (the "forebay dam"), then turns to meet the opposite side of the valley in a short section 200 feet long (the "wing dam"). The dam's owner, the U.S. Bureau of Reclamation, added the last two sections in the 1970s to bring water to six big new generators at the base of the forebay dam.

The massive dimensions of a grand dam

At its tallest, the dam is 550 feet high; at its thickest, 500 feet through. It isn't quite solid; it's mazed with nearly ten miles of galleries, stairways and shafts.

Drawing water from the lake are 24 main turbine generators, three service generators for internal electrical housekeeping, and six pumps and six pump generators on the west end. The three largest turbine generators each harness a million horsepower with rotating parts weighing 3,000 tons apiece. They take their water through 40-foot diameter tubes called penstocks that tap the upstream base of the newest part of the dam.

I posed The Question to some Grand Coulee engineers and geologists familiar with the area. "You mean you want to know what would happen if somebody blew a whistle and we all took our lunch boxes and went away for good?" asked Steve Sauer, chief of Grand Coulee's mechanical engineering branch. Exactly, I said. I added the premise that consumers would stop using electricity. They agreed to speculate, with the caution that other experts might conjure a different sequence.

"If you took the load off the power grid," said Jerry Pederson, chief of the water and power operations branch, "you'd start losing the main generators in days." As the power requirements fell, the resistance against turning would drop and the generators would spin too fast. Automatic controls would shut gates that allow water to flow in from the lake.

These gates are very important to what eventually would happen to the turbine generators. The six newer generators can protect themselves without human intervention: they would lower gates where water first enters the penstocks. They would also use hydraulic pressure to close a second set of gates that surround their turbines. These are called wicket gates, and they rotate open and closed like vertical Venetian blinds. Operators use them to fine-tune the amount of water reaching the turbines.

The 18 smaller, older generators are not as clever. They can close the wicket gates around their turbines, but only human operators can close the penstock gates to these generators. As long as station service power held out, hydraulic pumps would stubbornly keep these penstock gates up. The result: water in the 18-foot diameter penstocks, just waiting for the wicket gates to open.

Probably within a week, then, all main generators would have rolled to a halt. Only the three station service generators would still turn. They would supply power to hydraulic pumps, air compressors, lubricating oil pumps, water pumps in the sump pits of the dam, emergency battery chargers and lights. "The station service generators could last for months," said Pederson. "Among the three, at least one could go for months—a couple of years, even."

Moments after the last station service generator shut down for lack of maintenance, relays would tap a huge bank of batteries to power emergency lights and hydraulic pumps. After a few hours the batteries would die; darkness and silence would fall over the powerhouse. For the last time?

Generators rumble to life in the dark

No. Remember the wicket gates on the 18 older generators? These gates need hydraulic pressure to stay closed. Without power "they'll open back up to a 35 percent setting," said Jerry Pederson. That's not a lot, but the generators would be electrically isolated now. The turbines would be free to spin without opposition from the generators' electromagnets. It would be a sight worthy of any science fiction movie: in the dark and dusty powerhouses, all those generators that weren't shut down for maintenance at abandonment would rumble to life, as if answering some instinctive call to destruction.

Destruction, because the pumps that normally force oil between the thrust bearing and the rotating shaft would have no station service power; they cannot draw electricity from the main generators they service. Friction would heat the bearings quickly.

"A bearing failure is pretty scary," Pederson said. "Your first thought is to run. It starts hammering. If you're standing nearby, it's like somebody is hitting

Grand Coulee Dam, the largest concrete structure ever built, might well endure until the next Ice Age. But then the dam might be swept away by the same kind of glacial flooding we know occurred in past.

you on the soles with an eight-pound double-jack." In a bearing failure the heat-expanded tin coating of the bearing shaves off.

There's more. As shavings from the bearings wedged the first turbine generator to an abrupt halt, many tons of water would still be tumbling down the penstock every second. Pederson speculated that the pressure and mechanical damage "might destroy the head cover on top of the turbine . . . in that case, water would come up through the breach, onto the floor, and pour out the windows and doors of the powerhouse . . . it's a real possibility."

In that case, the escaping water would flood the turbine bearings of any units still running (p. 66). The water would float away any bearing oil that remained and help stop them.

Dams are not isolated structures. They rely on the integrity of dams upstream. Over several hundred years, chances are good that some extremely wet season would overtop one of the abandoned earthfill dams upstream. Overtopping is usually disastrous to earthfill dams; it starts gouges that keep getting bigger until all the water runs out.

Mica Dam, across the Canadian border and about 400 miles up the Columbia River, is one of the world's highest earthfill dams. "If a large geologic event should reduce that dam," said civil engineer Bob Miller, "there's no reservoir that could contain all that water."

Phil Hansen, the dam's chief geologist, believed that Grand Coulee Dam would emerge still standing after such a flood. But he guessed that the sides of the dam, at the abutments, would show scouring. "The right [east] abutment is probably the most vulnerable part of the dam," said Hansen. "Erosion there will make its own spillway."

If after 10,000 years or so water eroded the entire wing dam away to expose the granite bench underneath, there would still be water in the lake because the bench is 240 feet higher than the riverbed. Water would spill over the eroded east end of the dam, and down the bench to the riverbed. But most of the dam would be standing.

What might happen to Grand Coulee Dam after this depends on the next Ice Age. The last one in the Northwest peaked 12,000 to 14,000 years ago, according to radiocarbon dates from the Seattle area.

"The next Ice Age might finish it off," said Brian Atwater of the U.S. Geological Survey, "not just from bulldozing by glacial ice, but also from great floods that came from an ice-dammed lake in Montana."

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Water in dam's powerhouse would float lubricating oil away; turbine generators would quickly seize up.

Atwater referred to geologic evidence that during the last Ice Age a glacier blocked the Clark Fork River of western Montana to back up a tremendous lake: Lake Missoula, now vanished. At the peak of the last Ice Age, Lake Missoula held about 2,000 cubic kilometers of water, equal to 250 San Francisco Bays. Much of this huge volume of water occasionally escaped through Lake Missoula's glacial dam.

What did this water look like when it reached the present-day site of Grand Coulee? When modern dams break, like the St. Francis Dam near Los Angeles in 1928, there isn't enough water to sustain a high wave very far downstream. But the flood front from Lake Missoula was awesome. Geologist J Harlen Bretz wrote in 1969 that even 200 to 300 miles downstream from Grand Coulee, the flood front must have raced as a cresting wave at least 700 feet high. The legacy of such waves includes deep canyons cut into basalt—the largest of which is the Grand Coulee.

And even after this monster wave, the water kept coming, perhaps for weeks. How deep was the water at the site of Grand Coulee Dam? The floodwaters probably reached a 2,500-foot elevation, wrote geologist Bretz in 1932. That would be 1,600 feet deep over the current riverbed, and 1,200 feet over the crest of Grand Coulee Dam. And not just one flood but probably dozens because, according to Richard B. Waitt jr. of the Geological Survey, Lake Missoula issued at least 40 floods during the last Ice Age alone.

Explode the dam like a hand grenade

The impact of a wave 700 feet high might tear Grand Coulee Dam right off its foundations. Because of construction joints in the concrete, the dam would probably break into 50-foot-square columns like the grooved sections of a bursting grenade. Chunks of concrete might fly thousands of yards. And if anything were left of Grand Coulee Dam after the first dozen Missoula floods of the next Ice Age (opposite), Phil Hansen pointed out, then a glacier might come along and bulldoze out the remaining concrete.

If geology repeats itself, floods and glaciers will come to Grand Coulee again. How long before the next Ice Age? Maybe as few as 20,000 years, or as many as one million years. "It requires a substantial glaciation to cause Lake Missoula-style flooding," said Larry Hanson of Eastern Washington University at Cheney. "Although there have been many floods during the more recent glaciations, there is less evidence for flooding prior to 100,000 years ago. In the long term, this kind of flooding may be a rare event."

Most of the ancient Wonders of the World survived less than 1,000 years. The World Trade Center and the Gateway Arch, if abandoned, would probably last

the same range of time. That is pretty impressive, considering their slenderness and height. The ancient Wonders were squat by comparison.

Our big concrete dams, like Grand Coulee, will give the pyramids tough competition for the title of longest-lived artificial structures. If you are placing a bet, though, better put your money on the pyramids. They do not sit in a riverbed. These artificial mountains might pass a million birthdays and outlast mankind.

Our country's longest-lasting structure would probably be the deeply buried North American Aerospace Defense Command combat operations facility near Pikes Peak in Colorado. Protecting the steel buildings in their blasted-out caverns is a 1,700-foot-thick granite roof called Cheyenne Mountain.

Meanwhile, we'll have to be content with buildings and bridges and dams that deteriorate rather quickly without upkeep. Structural engineer Les Robertson had something to say on this. "The idea of a 50- or 100-year life span for buildings is patently ridiculous," he said. "There's no structural reason not to go on and on and on." He explained that any piece—and he means *any* piece—of a steel building can be pulled out and replaced. "The effective life span is completely dependent on those who maintain them. Properly maintained, a building is ageless."

In this artist's conception, Grand Coulee Dam lies breached after being struck by 700-foot wall of water. Such flood fronts occurred during geologic times when the ice dams around huge glacial lakes gave way.

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By Roderick MacLeish

Gifted by nature, prodigies are still mysteries to Man

Extraordinarily talented children have been astonishing audiences for centuries, but scientists don't know what makes them tick

A master of the keyboard at seven, Mozart achieved greatness as a composer, but died before he was 36.

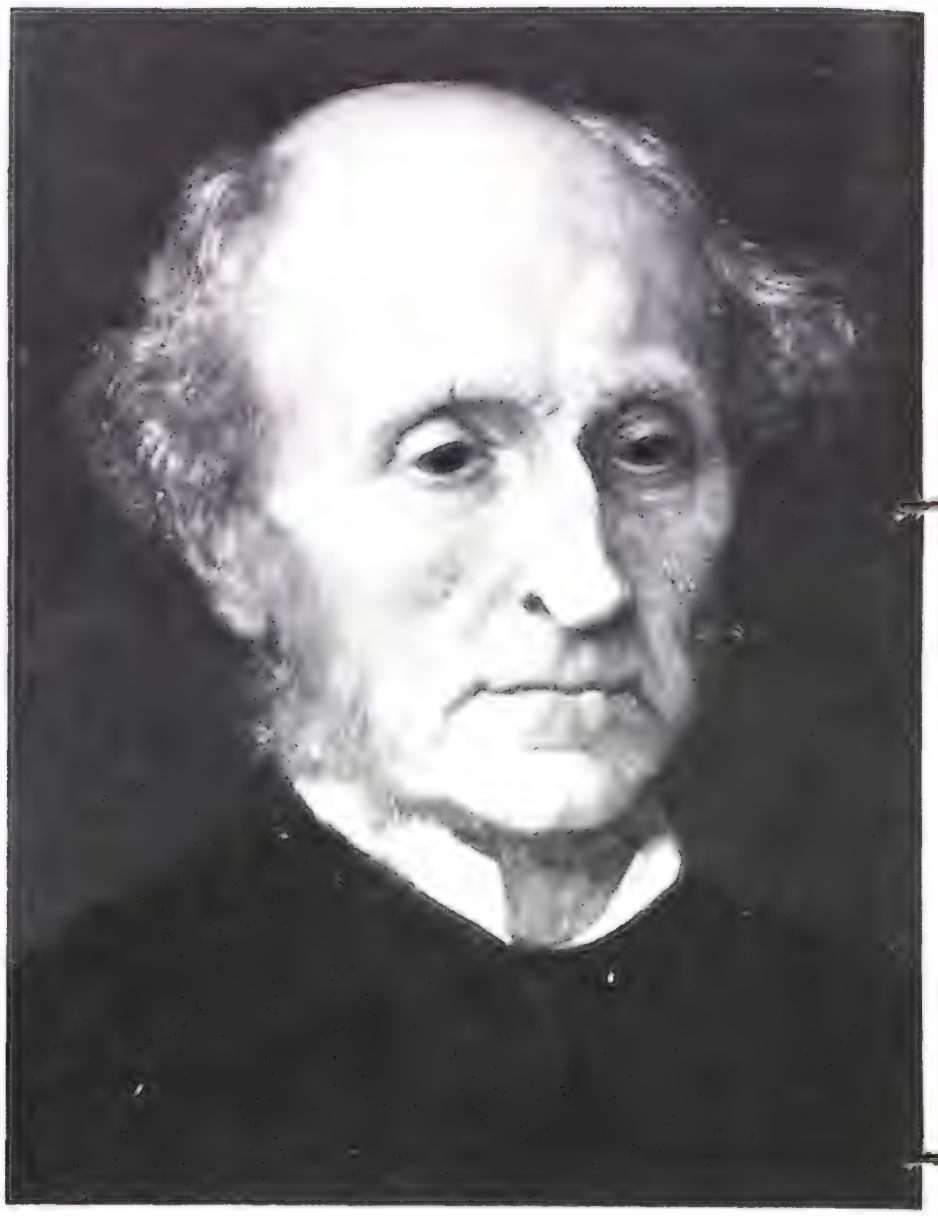
In the summer of 1764, London turned itself inside out to celebrate the 26th birthday of George III. The streets were crowded with visitors, jugglers, puppet shows and pickpockets. The warm June nights glittered with the plumage of the gentry at balls and levees. At the Great Room in Spring Garden, two sensational Austrian children were on display. Their father had advertised them in the newspapers as "Prodigies of Nature." The little boy, Wolfgang, was eight and his sister, Marianne, was 12. Their mature, effortless skill at the organ and harpsichord amazed everybody who heard them. They could play any music presented to them at first reading.

By then, Wolfgang Amadeus Mozart was already an established child celebrity. He had performed, and charmed, in half the great cities of Europe. The Holy Roman Emperor, Francis I, had proclaimed him "a little magician." He had composed chamber music of extraordinary technical virtuosity and he was about to write his first three symphonies. When Mozart died shortly before his 36th birthday, he left two legacies. Ultimately, the world recognized him as one of the finest composers who ever lived. And he will be remembered forever as history's most famous child prodigy.

"The little world of childhood with its familiar surroundings," wrote the distinguished Swiss psychologist Carl Gustav Jung, "is a model of the greater world." But it is as true today as it was in Mozart's time that prodigies may not fit into either world. They are blessed by phenomenal gifts denied to everybody else they know. They tend to display those gifts in fields where few others excel—in mathematics, music and chess, less frequently in literature and art. They enjoy, many of them, the sublime satisfaction of extraordinary achievement, the thrill of public adulation and the material wealth such success can engender.

Even so, there are afflictions as well as rewards for the prodigiously talented. Some prodigies pay for their genius with a tormenting sense of their own uniqueness. Some become targets of bewildering hostilities. Some burn out early at the peak of their powers while others self-destruct before ever fulfilling their early promise. As adults, even the most successful prodigies sometimes question the value of their lives and accomplishments. "I have a longing which grows stronger as I get older," confesses the acclaimed Ameri-

At 11, literary prodigy Mac Randall has written poems, stories and one opera, but he worries about friends.



British philosopher John Stuart Mill read Greek at three and suffered a shattering mental crisis at 20.

can concert pianist Eugene Istomin, "to be mediocre."

One of the leading practitioners in the relatively new field of prodigy research is psychologist David Henry Feldman of Tufts University in Medford, Massachusetts. Feldman divides prodigies into at least two groups. Omnibus prodigies, he says, are those who excel in two or more fields of endeavor, whereas single-purpose prodigies, like Mozart, have one supreme gift. Single-purpose prodigies far outnumber their more versatile counterparts.

Perhaps the best-known example of a single-purpose prodigy in the 20th century is the American violinist Yehudi Menuhin. Born in New York in 1916, he began lessons at five and made his debut with the San Francisco Symphony Orchestra when he was seven. Critics were astounded by his technical virtuosity and uncanny understanding of the great works he performed. Still active today, he remains one of the world's most revered musicians.

Children of uncommon talent have been amazing their audiences for ages. One of the musical world's most conspicuous youngsters was the pianist and composer Felix Mendelssohn. Born in Hamburg 175 years ago, he had composed a fair amount of music by the time he was 11. When he was 16, he had already written 13 string symphonies and some of his most imaginative chamber music. His fourth opera was produced in Berlin when he was all of 18.

John Stuart Mill, the prominent 19th-century British philosopher, is another of history's celebrated child prodigies. He was force-fed an education by his father, the historian and economist James Mill. John Stuart read Greek at three and became his sister's tutor when he was eight. He had worked his way through elementary geometry and algebra, and a vast body of literature and history, by the time he was 12.

Born in 1881, Daisy Ashford was the child of British Roman Catholic parents. At four, she produced a comic masterpiece about a Jesuit priest that featured a fictional Pope's visit to London. Her famous novel, *The Young Visiters*, was written when she was nine. It is a funny, utterly enchanting portrayal of genteel life in the Victorian era from a child's point of view. *The Young Visiters* sold hundreds of thousands of copies over many decades and is still in print. Daisy stopped writing as she entered her teens. She died at 90 in 1972.

Unhappily for many prodigies, success has not always been accompanied by equal measures of happiness. When he was 20, John Stuart Mill suffered a shattering mental crisis. Overwhelmed by despair, he began to question the struggle for erudition which had occupied his life. "The end had ceased to charm. . . ." he wrote years later. "I seemed to have nothing left to

Novelist, critic and journalist Roderick MacLeish is a commentator on National Public Radio. He lives in Washington, D.C., when he is not traveling abroad.

Felix Mendelssohn's fourth opera was staged when he was 18; he had already written 13 string symphonies.

Daisy Ashford wrote a best-selling novel when she was only nine. She stopped writing several years later.

live for." Other well-known prodigies experienced similar setbacks.

A number of history's most famous prodigies had something else in common: they did not live exceptionally long lives. Raphael produced masterpieces as a teenager and died on his 37th birthday. Composer Franz Schubert died when he was 31. Scientist Blaise Pascal died before he was 40. It is almost as if nature, in compensation, endowed these and other prodigies with a capacity for immense productivity.

Dr. Rima Laibow, a child psychiatrist in Dobbs Ferry, New York, has observed firsthand the problems that bedevil contemporary prodigies. They live, she says, under the burden of their isolation and, to make matters worse, the role of a destructive force is often unwittingly thrust upon them. "They create immense competitiveness in their families," Laibow emphasizes. "The kid's smarter than his well-educated father. The resentment spills out. . . . It's very difficult to have one child performing phenomenally while everybody else is poking along the way most people do."

Educating prodigies can be a serious problem, too. In school with children their own age, they become bored, frustrated and may simply switch off learning altogether. If sent to a university where his intellect can be accommodated, a ten-year-old genius can't fit in. Emotionally, he's still ten.

The parents of normal children often feel threatened by child prodigies. Laibow tells about a three-year-old who was sitting in a playground sandbox drawing the schematic design of a car he was inventing. The mother of one of his playmates came over and erased his intricate markings in the sand. "Children shouldn't be allowed to do those things," the woman said. "It just confuses them." The little boy had in fact been deeply engrossed in what was, to him, fun. "It wiped him out," Laibow says.

There is another baffling phenomenon: the child prodigy as fantasy-inspirer. Sidney is nine. He is a classic omnibus prodigy. At birth he registered the neurological reactions of a three-month-old baby. At four, he could write and read nine languages. He has

Psychologist Feldman: "All the things that go into a prodigy must coincide."

Psychiatrist Laibow: the prodigy creates "immense competitiveness. . . . The resentment spills out."

the potential talents of a virtuoso violinist. When he was 22 months old, Sidney began studying Hebrew with a private tutor. "She was wonderful with him," his mother recalls. "She sat on the floor with him, taught him, cuddled him and played with him. Then one day I walked in and heard her telling Sidney he was the Messiah." Sidney finished his instruction in Hebrew with somebody else.

Many children, as they enter adolescence, begin to turn away from their families and toward their fellow teenagers for affection, support and a sense of belonging. This can be a particularly rough time in the lives of child prodigies. They know they're different. Other adolescents know or sense it, too. The prodigy may simply bury his genius to win social acceptability. Or he may plod on, brilliant and alone. "The suffering," says David Feldman of Tufts, "can be severe."

Mac Randall is poised at the edge of that adolescent minefield. At 11, he is a slender, self-possessed boy with the vocabulary of a grown man, a subtle sense of humor and a Christopher Robin haircut. He taught himself how to operate an electric typewriter when he was three. At four he began to write horror stories and fantasies. To fuel his writing, Mac worked his way through studies of the solar system, dinosaurs, the lives of composers and the history of comic strips. He also read parts of Shakespeare, Henrik Ibsen and Edmond Rostand. His own literary output is less remarkable for structure than it is for depth and maturity of content. His ideas range across philosophy and religion to startling memoirs.

Mac is the only child of a second marriage. When he was little, his family lived in the country surrounded by animals. "If you want to get right down to it," Mac says, "I was raised by two dogs, some cows and horses." His mother, Janice, a former schoolteacher, began to get concerned about him when he was four. "He was just learning so much," she recalls. "He really did have to come to an understanding of where he had to limit his emotional responses. One day I found him in tears listening to a recording of *Romeo and Juliet*, and that was sort of *it*. He knew that he simply couldn't allow himself to go on that way." As for being hyperstimulated, Mac agrees. "I used to be," he says. "But I've calmed down a lot now."

When Mac was six, his parents moved to the city so that he could have friends and get the special schooling they felt his gifts demanded. He is guarded about the whole subject of prodigious children, as if he senses the problems that may lie ahead of him. "I never tell anybody that I'm a prodigy," he says, "but they eventually find out. When you do it that way and don't go around saying, 'Hey, I'm a genius,' they sort of like you a lot more."

Lately, Mac's creative drive has begun to focus on other things besides literature. Since he was two, he has been fascinated by music. He began with the classics, on which he holds firm opinions. "I still have a fondness for Bach," he says. "I enjoy Beethoven's Seventh. I don't like the Pastoral Symphony." With the death of John Lennon in 1980, Mac became absorbed in rock music and recently finished writing the music and libretto of a rock opera.

Like most adolescents, Mac is no stranger to apprehension. The difference is that he can articulate his with considerable candor. "I'm afraid of not having

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A sensational prodigy, violinist Yehudi Menuhin did not burn out or quit. Now, at 67, he is still revered.

any friends. I used to be not a very social person but I knew a lot of people who were, so I took on their characteristics. Now I'm a much more open person." An interviewer asked him recently if his precocity has presented him with any serious problems. The grin faded. Mac looked at the questioner for a moment. "Not yet," he said cryptically.

Jaime Laredo, the Bolivian-born violinist, was brought to the United States by his family to find teachers who could cope with his extraordinary talent. Laredo says he knew that he was slightly special as a little kid. "But I don't remember ever being teased or anything like that," he says. Unlike Laredo, pianist Eugene Istomin, 58, felt alienated as a child. The son of Russian immigrants, he was raised in a musical home and, as he recalls with some irony, was once "put in a school for little geniuses." He speaks of creating "masks of regularity" for himself to deal with the world. "I had," Istomin says, "no connection with other children except through sports." Consequently, he played street games, boxed and became a rabid baseball fan, which he still is.

Another rough time for many prodigies occurs with the advent of the so-called "mid-life crisis," which usually occurs in the teenage years. "The mind starts asking you questions," says Jean-Bernard Pommier, the French concert pianist and conductor. "Who are you? What do you know? What is the difference between you and other people? If you aren't prepared to answer these questions, you can be lost."

By "lost" Pommier is referring to what students of the prodigy phenomenon call "burnout." It is, simply, a sudden end to a brilliant young person's interest in learning, in performing, in *being* brilliant.

Norbert Wiener and William James Sidis were turn-of-the-century child prodigies who both were educated in Cambridge, Massachusetts. Wiener graduated from Tufts at 14, won his doctorate from Harvard before he was 20 and went on to become one of the great mathematicians of his time. He was a pioneer in the field of cybernetics, a science which forms part of the basis of computer technology. Sidis entered Harvard when he was 11. He amazed his teachers with a lecture on mathematics. Newspapers and magazines wrote articles about him. Then Sidis graduated and dropped out of sight. He drifted from job to job and ended up living alone. His major interest seemed to be collecting streetcar transfers from all over the world. He died at the age of 46 in 1944. Sidis burned out. Wiener did not. What was the critical difference between the two child prodigies? Nobody really knows.

Notwithstanding centuries of fascination with child prodigies, there has been little serious study of them until recently. Work is under way now at several major universities, and some interesting common denominators have been identified.

The vast majority of prodigious youngsters are boys. They tend to be the first-born children of middle-class families. Often, their parents are beyond the usual child-bearing age; many prodigies apparently are born by Caesarean section. There is a high incidence among child prodigies of parents who seem to be trying to realize their own ambitions through their amazing offspring. And, curiously enough, prodigies tend to have a bizarre and, occasionally, a downright off-color sense of humor.

Even now, prodigies defy definition

Despite the recent upsurge in research, there is still no universally accepted definition of the child prodigy. Webster's dictionary says a prodigy is "a highly gifted or academically talented child." That's pretty vague, and David Feldman of Tufts prefers a somewhat more specific description because of all the variables in the lives and traits of superbright children. "A child prodigy," he says, "is a person who performs at or near the level of a professional at a very early age."

The conventional yardstick of intellectual ability is a standard IQ test. Many educators consider anyone who scores above 150 or so on such tests to be a "genius." But Harvard University psychologist Howard Gardner believes IQ tests probably fail to identify many brilliant and talented youngsters because they focus on only two skills, language and mathematics.

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Only child of a second marriage, Mac Randall taught himself to use electric typewriter when he was three.

In his provocative new book, *Frames of Mind: The Theory of Multiple Intelligences,* Gardner asserts that the human mind is not a single entity but a constellation of seven specific intelligences, each controlled by different parts of the brain. These intelligences include musical ability, bodily talent, spatial perception and personal sensitivity as well as linguistic and mathematical skills. They develop according to their own timetables and they operate independently, but they can function cooperatively, as well. One or more intelligences can outshine the rest, Gardner says, and musical talent is usually the first intelligence to emerge—conceivably because musical ability does not seem to require as much experience in the real world as other skills.

Gardner's theory of multiple intelligences appears to offer a possible avenue to understanding the prodigy phenomenon. But how is the seed planted in the first place, and what is the scenario for its full flowering? Initially, Gardner speculates, a youngster's potential for a particular kind of brilliance is transmitted by the parents, who may not have any special gifts themselves but who do have talent in one or both family backgrounds. The child's extraordinary ability is usually revealed at an early age by a crystallizing event—a moment of revelation which signals to youngster and parent alike that the talent is there.

"Just having the gene is not enough," Gardner maintains. "The potential has to be triggered by something in the environment, and it must be nourished."

David Feldman concurs with Gardner's emphasis on the importance of nurture as well as nature. In fact, Feldman is the originator of the "coincidence" theory of child prodigies, which holds that, for genius to occur, "all of the things that go into it must coincide at exactly the right time, in exactly the right place under exactly the right conditions. There has to be a cultural preparation and an appreciative audience."

Feldman's coincidence theory goes a long way toward explaining certain conspicuous historical explosions of genius—the outburst of great literature during the Elizabethan era, for example, and the torrent of immortal music that flowed out of Vienna in the 18th and 19th centuries. Currently, Feldman says, about 50 percent of the chess prodigies in the United States live in San Francisco, Los Angeles and New York. Their homes are in population centers where there are chess clubs—where interest in the game runs high. Seven-year-old chess whizzes in these three cities can test themselves against other gifted or experienced players. They have been born in a period of history which believes in encouraging chess prodigies.

"Imagine Einstein being born in the same place—but 5,000 years ago," Feldman says. "He would have been walking around wondering why there was air, but he might not have made it to his 12th year."

There is some evidence that the nation's population of gifted children—and, possibly, prodigies—is growing. James T. Webb, professor and assistant dean at Wright State University in Dayton, Ohio, reports that staff members at the institution who test large numbers of children have detected a startling proportion in the 170- to 180-IQ range. "Something strange is happening out there," he says.

Superbaby diet: tapioca, Bach and math

One strange thing that is happening out there is the appearance of the so-called "superbaby movement." Ambitious mothers and fathers are flashing vocabulary cards at their toddlers as they eat their tapioca, and feeding them a diet of mathematics and Johann Sebastian Bach to boot. Glenn Doman, a Pennsylvanian with a background in physiotherapy, is considered the reigning prophet of the superbaby movement. He has proclaimed that "our individual genetic potential is that of Leonardo, Shakespeare, Mozart, Michelangelo. . . ."

Many child development specialists are worried about the effects of trying to pressure kids into prodigiousness. Pediatricians are seeing children with backlash symptoms: headaches, tummy-aches, hair-tearing,

anxiety and depression. This kind of pressure, says child psychiatrist Rima Laibow, "makes for trouble."

Another, even stranger development is the Repository for Germinal Choice, a sperm bank in Escondido, California, which accepts deposits solely from donors who are outstanding intellectual achievers, including Nobel Prize winners. Not long ago, an unmarried Los Angeles psychologist, Afton Blake, selected as the father of her child a computer scientist, who was identified by the repository only as Number 28. At four months, the child, a boy named Doron, had the motor skills of an infant twice his age and now, at one and a half years, he evinces special interest in music.

Implicit in developments like the repository and the superbaby movement is the notion that children are mere commodities. This view disgusts many of the researchers and psychologists who are studying phenomenal young human beings—primarily because these children are natural, if unusual, members of the human family. Above all, scholars of the child prodigy phenomenon are filled with wonder at the mystery which confronts them daily. Recently David Feldman was asked to speculate on why a Mozart or a John Stuart Mill suddenly appears in the endless river of mortal generations. Do prodigies get that way because of environment, genes or God?

The young psychologist thought for a moment. Then he shrugged. "Perhaps all of the above," he said.

Doron Blake's mother selected father of her child at a California sperm bank reserved for outstanding intellectual achievers. Although not yet two, Doron is already demonstrating a special interest in music.

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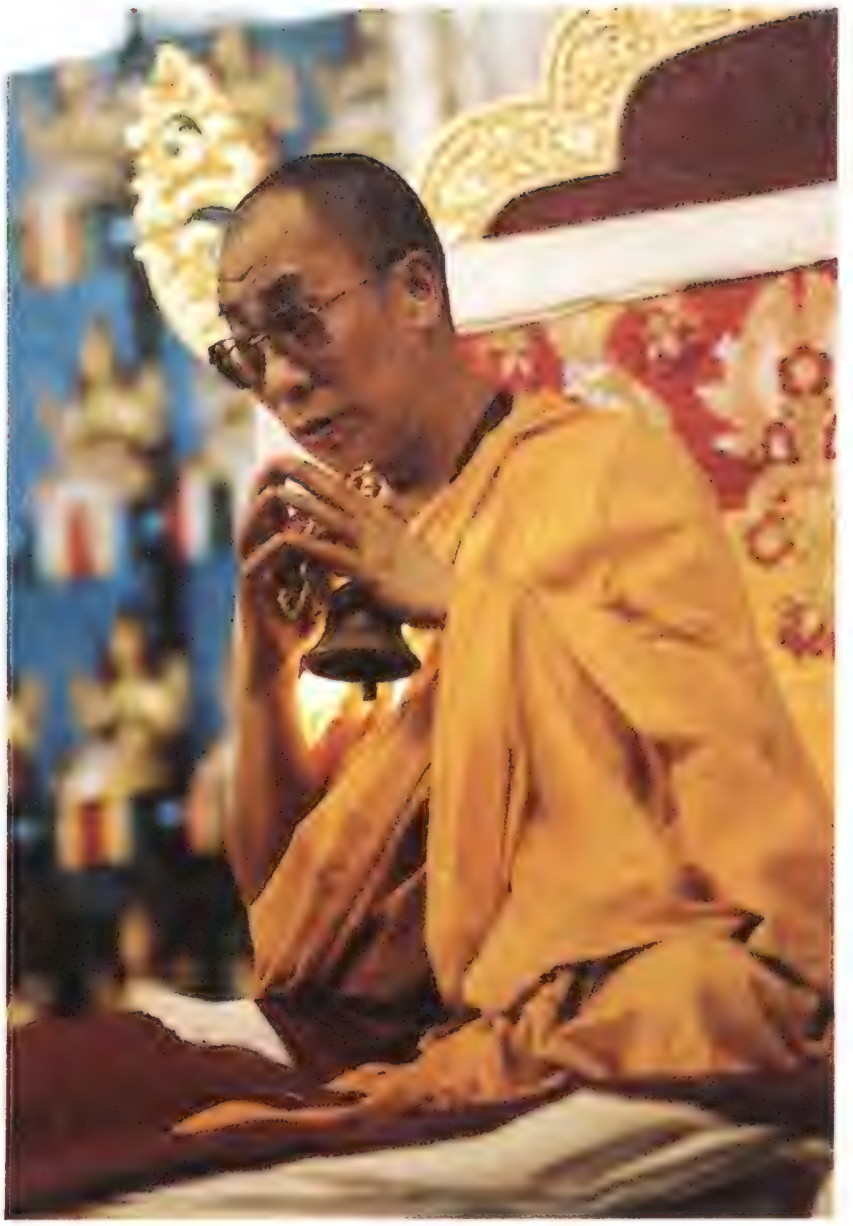
Article and photographs by E. Richard Sorenson

To Tibet's Dalai Lama, exile is a haven—and an opportunity

For 25 years this very spiritual man, bent on preserving his people's cultural identity, has also worked to sustain Tibetan Buddhism



In the month-long traditional Monlam prayer festival, held at Drepung Monastery, a senior monk, at left, bows reverently to the Dalai Lama (above), presiding over the ceremony for the first time since his exile.

The invitation from the commanding general of Mao Tse-tung's forces was most unusual. He was to come to a theatrical performance in the Chinese army camp outside Lhasa—without retinue: neither his traditional escort of 25 bodyguards, nor the ceremonial armed troops who always lined the wayside wherever he went. The visit must be kept secret from the public. It was humiliating, but with Lhasa, his capital, in turmoil and guerrillas in the countryside fighting Chinese troops, he feared reprisals against his people if he declined. Nevertheless, word got out and Norbulingka Palace was engulfed by some 30,000 Tibetans, convinced that their beloved leader was about to be kidnapped—or worse—and determined to protect him. Then mortar shells exploded nearby. His course became clear; the 24-year-old Dalai Lama, spiritual and temporal head of all Tibetans, must leave.

In 1950 Mao's troops had moved into Tibet and initiated a program of "modernization" which began to destroy much of a religion and a way of life more than a millennium in the making, a unique and to us mysterious civilization respected worldwide.

And so on the night of March 17, 1959, the 14th Dalai Lama, disguised as a soldier, with the unfamiliar bulk of a rifle slung over his shoulder and barely able to see without his glasses, slipped from Norbulingka in darkness. He was accompanied by his chamberlain, an abbot and three bodyguards. Members of his family, monks and cabinet ministers, along with other bodyguards, left in small groups. Safely across the Kyichu River in skin coracles, they ferried the mighty Tsangpo (Brahmaputra) and moved swiftly southward, on foot and on horseback, along twisting, rocky trails through roadless mountains. Always fearful of pursuers, but succored along the way by monastic communities and Tibetan families, the 80-odd refugees withstood torrential rain, dust storms and a freezing, blinding blizzard on Lagoe Pass. After a tortuous two-

In long-established Likir monastic library, Ladakh, woman venerates books of Tibetan Buddhist scripture.

At year-end Mahayaksha ceremony, Yonten, a young Zonkar Choede monk, participates in Black Hat dance.

week journey, they crossed the border out of Tibet.

The Dalai Lama was assured of refuge in the India of Jawaharlal Nehru, and at the Himalayan foothill town of Mussoorie he was welcomed graciously by the Prime Minister himself. Given not only sanctuary but land near Dharmsala, a small village on a southern promontory of the Himalayan range overlooking the great plain of India, the Dalai Lama established his headquarters. With the survival of a culture resting in his hands, he set about establishing monasteries and villages where the traditional Tibetan values would be preserved.

During the next two decades more than 100,000 Tibetans followed him into exile; the exodus encompassed virtually the entire spectrum of Tibetan society: government officials—both monastic and lay, businessmen and traders, high lamas and ordinary monks, farmers and nomads. A like number may have perished en route. From the far eastern province of Kham the people of several villages and monasteries, with 5,000 of their yaks and sheep, fought their way for two years across a thousand miles of Tibet into Nepal. Others went as far as Europe and America. But most crossed hundreds of miles of roadless, turbulent country into India—individually, in family bands and large groups.

The sophisticated, humanitarian response of India played a crucial role in their resettlement. It is not a wealthy country, nor does it have surplus land. Yet the government provided huge tracts of precious forest reserve, where the land was good. It was a gesture not easy to make in an overpopulated, ecologically poor

Lamas at Gyudmed Tantric College create mandala, using colored sand. It is destroyed at end of ritual.

Dalai Lama commissioned images of Padmasambhava to face toward Tibet from north, south, east, west.

country, an act of true generosity and compassion.

The Tibetans who fled to India were first put to work building roads in that country's Himalayan border areas. Today they are settled in the many large tracts provided by the Indian government, mostly in the south. Major monastic universities and the principal tantric colleges, destroyed in Tibet, have been rebuilt. More than 150 Tibetan monasteries, major and minor, old and new, now dot India and Nepal. A Tibetan Medical Center was founded. There is a Library of Tibetan Works and Archives in Dharmsala, protecting and preserving literary and artistic treasures, and facilities for a quarter of a million feet of film recording the traditional Tibetan way of life. A Tibetan Opera and Drama Society travels and performs throughout the Tibetan exile communities and abroad. From his eyrie in Dharmsala, the Dalai Lama keeps a close watch over all, aided by his cabinet ministers and an elective body made up of exile representatives from the religious sects and main provinces of Old Tibet.

That country, which has been called "the Roof of the World" by outsiders and by its own people "the Land of Snows," commands a high plateau with an elevation of between 10,000 and 16,000 feet above sea level, surrounded and intersected by mountains. It was an independent kingdom by the seventh century A.D., but foreign incursions by petty kingdoms as well as the great dynasties of Mongolia and China have marked its history. Despite these inroads, the Tibetan identity remained intact, with its own language, culture, customs, alphabet, calendar, legends and government. Then, after the overthrow of the Manchu dynasty in 1911, Tibet saw, and seized, the opportunity to cut off further influence from China. The Chinese mission was expelled, and not until 1950 did the Chinese reenter the country in force.

They proceeded cautiously at first, but as more and more Chinese poured into Tibet food shortages and the cost of living increased. Sporadic revolt broke out. Suspicion about Chinese motives as well as unrest and panic culminated in the incidents that drove the Dalai Lama into exile. Within two days after his departure, the Chinese bombarded his palaces, killing thousands of Tibetans. They dissolved the Tibetan government, and private property, including that of the monasteries, was seized. Monks were driven into other occupations. Still more of what had been Tibetan in the country the Dalai Lama once ruled was erased in the late 1960s, when shock waves of China's own cultural revolution spread to Tibet. At least 90 percent of the ancient monasteries were destroyed. Even nomads were forced into communes. Much of Tibet's artistic heritage and religious articles of great beauty were either shipped off to China or smashed. Tibetans lovingly pulled from the debris whatever they could rescue and hid the precious fragments, or carried them into exile.

"As soon as we left Tibet we became exiles," the Dalai Lama told me. "But for political, not economic

For nearly 20 years, Dr. Sorenson has made research film studies of vanishing and changing ways of life and culture throughout the world.

Abbot of Tashilumpo engages Konchok Tashi, brilliant student from Gaden, in spirited dialectics.

Hand gestures have precise meanings: Konchok's indicate that he has just made a critical point.

reasons. We decided that our number one priority must be to stand on our own feet, and work hard for self-sufficiency." (Luckily, he had means at his disposal with which to make a start. When in 1950 it appeared he might have to go into exile, the Dalai Lama deposited gold and silver in Sikkim. Since 1959, occasional help has come from foundations and from wealthy Tibetans living abroad.) He continued: "We planned and founded large communities to preserve Tibetan culture and atmosphere, where we could establish monasteries and build Tibetan schools so our children could learn our history, language and philosophy. But we also decided that we needed modern education. We wanted to progress as a modern nation."

Why, I asked, is it so important, in a world where cultural diversity is being eroded so rapidly, to preserve these values? The Dalai Lama replied: "Tibetan culture is unique. Because of it Tibetans face problems more easily without losing courage or determination. It gives inner strength. Besides, it is nice."

The simplicity of this remark charmed me, and I said so. It was in keeping with his modest comment: "But I am just a simple Buddhist monk."

Simple Buddhist monk he may be. He is also one of the most winning and complex men I have ever met. This is manifest daily. His religious and administrative duties are legion. Presiding at important monastic rituals, he is dignified but not remote. He is accessible. After the formalities of the Great Monlam festival last year (pp. 82-83), he greeted personally all who wanted to speak to him: monks, refugees and Tibetans who had crossed the border to attend. With an old woman and a child he was warm and sympathetic. He is not so different when giving audiences or, as secular head of his people, administering, through shrewdly and carefully chosen ministers, a complicated governmental apparatus that reaches into every refugee settlement.

The Dalai Lama had spoken of Tibetan culture giving an inner strength which protects against psychological breakdown in new situations—in our parlance, culture shock. Arriving from an isolation rare in this world, untutored and inexperienced in other ways of life, most Tibetans had only what they were able to carry out on their backs. The physical differences between the high plateau of Tibet and the plains of India are probably as great as any the world can provide—terrain, climate, plants and animals. But right away the refugees began to reconstruct their lives. In the rarefied altitudes of Tibet the yak is the principal work and dairy animal, but it cannot survive in the lowlands. And so the exiles learned to raise cattle. Many settlements now have a flourishing dairy herd. Refugees have mastered operating—and repairing—tractors. Centralized warehouses store their corn until the optimum time to sell. In all the communities carpet weaving thrives, and Tibetan carpets are in demand throughout Europe, America and Australia.

Buddhism was established as the state religion of Tibet in the eighth century A.D. when King Thi-srong-detsan invited the Indian scholars Santiraksita and

Padmasambhava to his court. Then the kingdom's first monastery was built. Tibetan Buddhism's special character derives from the amalgam of Indian Mahayana Buddhism, tantric mysticism and a Central Asiatic shamanism. Tibet's holy men, the lamas, may be schooled in dialectics at the monastic universities and in tantric practice at special tantric colleges.

Trying to put Tantric Buddhism into words is a bit like trying to catch a falling star. That is because it deals with so much nonlinguistic expression. Whereas dialectics is logical, articulate inquiry into the nature of existence, tantric practice goes beyond language and logic in pursuing the same goal. Those who engage in it say it requires direct transmission between teacher and student at key times, something vaguely similar to what we call clairvoyance. (It was at Gyudmed Tantric College that I learned the so-called Tibetan gods are not gods at all in the Western sense. They represent mental states to be evoked in meditation and ritual, a means of training the mind toward a more accurate appreciation of the human condition.)

"Dalai Lama" is the official title of the head of state of Tibet and its holder is considered the incarnation of Chenreze, the Bodhisattva of Compassion. When a Dalai Lama dies, oracles, dreams, occult signs and divinations tell the state religious leaders where to look for his reincarnation. Possible candidates are shown a number of objects, including some personal possessions of the deceased Holy One, along with their duplicates. It is considered an important sign if a child picks out the genuine article. The search can in fact be long and far-ranging, an exhaustive examination of many candidates.

There have been 14 Dalai Lamas, and the current one has said he might be the last. I inquired about this. "At present, the Dalai Lama is very useful, very helpful for Tibet. That is why I am serving. But when the institution of the Dalai Lama is no longer of use the Dalai Lama will disappear."

Tibetan Buddhism: giving and receiving

He has traveled tirelessly, throughout India attending Buddhist ceremonies and visiting refugee settlements and, by invitation, to other Asian countries, the Americas, Europe and Australia. All around the world he has carried his message of determination that Tibetan Buddhism and its way of life shall not be lost—and that it has a great deal to offer to, as well as receive from, other cultures.

"Buddhism is not theistic," he says. "It is heavily dependent on logic and reason. However, we also accept the value of nirvana [a state of supreme liberation, bliss and understanding]. So there is a common language between persons of strong faith and Bud-

Monastery watchdog doubles as impromptu desk for young monk, intently memorizing Buddhist scripture.

Toting a big pan of cement, youthful Sakya novice in Nepal struggles to help build his monastery.

In completed monastery other novices, honoring their protective deity Mahakala, blast forth on horns.

dhism. I believe that the different religions, different philosophies, different systems and ideologies were all meant for human benefit. The world is becoming smaller and smaller. So now is the time to forget our differences. World peace will not come through heated competition, but only through brotherhood."

To the Dalai Lama there is no inconsistency between the esoteric principles of existence which lie at the core of Tibetan philosophy and 20th-century science: both rely on logic and reason. "While the ultimate goal of Buddhism is nirvana, our immediate goal is worldly benefit. As Buddhists, we have a deep interest in society, community. Our continual investigations for the worldly benefit of Man rely on observation and logic, so they are scientific. If scientific reasoning proves something different from our scriptures, we accept the proof rather than the scriptures. The human mind is the real creator."

Like any monk, he spends many hours meditating. But he also listens to the news—the BBC and Voice of America—receives reports, makes decisions and long-range plans, handles correspondence, confers with his officials. The afternoons are reserved for audiences with diplomats and journalists, scientists and religious figures, Nobel Laureates and leaders from all over the world, as well as Tibetans from refugee settlements, discussing such diverse subjects as the restoration of Borobudur in Indonesia, theoretical physics, a new well for a settlement or threats to world peace.

The true keepers of the flame of Tibetan Buddhism were the great monasteries, where it was taught, nurtured and refined for 13 centuries. It is, therefore, in the reestablished monasteries that one must look for much of what it is that makes Tibetan culture worth protecting and preserving. But it is in the Tibetan lay communities that one must look to see how the children develop that special responsiveness which lends itself so well to adaptability and monastic involvement.

Shey Monastery, serene and ancient, is one of several which were built in the Indus River valley.

On the five continents and several isolated islands where, for two decades, I have studied child behavior and human development in disappearing and changing cultures, I have seen no equivalent to the kind of reciprocal generosity and respect which extend from older to younger and younger to older within Tibetan communities. A small, but indicative, example can be seen in one of my research films of a traditional Tibetan household in Ladakh. A ten-year-old, dipping milk from a container for himself, saw his toddler brother watching wistfully. Without hesitation he took his cup to the toddler, handing it over with grace and deference, helping him to drink. This sort of thing

Nestled between two mountain ranges, it watches over a tiny Ladakhi village and its croplands.

happens again and again. So, when butter tea was served, the little one insisted on carrying cups to his elders, lurching unsteadily but determined to do his part. This mutual respect for the interests of others seems to deter development of disagreeable traits such as anger, contentiousness, bossiness or recalcitrance.

And so in the monasteries even very young boys of six or seven adjust and learn quickly the religious texts, complicated instruments and music, styles of presentation. Although formal rituals can last for days, tiny novices remain attuned, physically and mentally, to the ceremony and those performing it.

During the past 15 years I have observed and visited more than 40 monasteries in India and across the Himalayas. Although I knew all were bound by the same rules, I saw how very different they were one from another and wondered how they could possibly reconcile such divergence into a single Buddhist practice and philosophy. But I came to see that since their Buddhism does not recognize the reality of what we perceive (for example, hearing, seeing, feeling, even visualizing are not as they seem), personal penchant may have wide scope. This is illustrated in adult lamas' attitudes toward young monks. So long as what they do is not so disruptive or offensive that it impinges on others, it is considered not to have happened. Therefore, curiosity and delight in exploring —dominants in the Tibetan character and traits which

Incarnate lama Shabdrung Rinpoche plays cymbals during invocation at Mathoo monastery in Ladakh.

one sees in the Dalai Lama himself—are acceptable.

At Zonkar Choede monastery novices propel themselves into each new day with a dazzling display of spontaneous exploratory zeal. While they accept monastic study and memorization cheerfully enough, what stands out is tussling, frolicking and examining.

Nearby, the famous Gyudmed Tantric College stands in marked contrast. A quiet gentleness pervades. Expressions of personal predilection and exploration are there, but what one remembers is the intensity of the intonations of study and ritual.

And at the reestablished monastic universities of Gaden, Sera and Drepung, truth is sought through logic and language, in dialectic inquiry. Rigorous and athletic, with specified stylized movements (p. 86), these exercises, fundamental to monastic training, are engaged in for hours each day. One observing for the first time several hundred monks of all ages in front of a monastery, leaping, twirling, waving their arms, laughing and shouting, might think a roisterous spree was in progress. Not so; the approach to dialectics is earnest but joyous, and illustrates perfectly the laughing, sparkling element in the Tibetan religion.

It is extremely difficult for the Western mind, at first, to grasp and follow these inquiries. One morning at Gaden a teacher, an elder monk, proposed to two novices the premise that "whatever is a form is necessarily a shape form." One novice, whom I shall call the "initiator" (who always stands) spun round and clapped his hands, presenting to the "respondent" (always seated) a subject for inquiry: "color form." For the ensuing half-hour I watched and listened as they dissected and examined all possibilities. They established that a color form is matter, that it is indeed a form but not a shape form, that a house is an example of both form and shape form. Asked to suggest something neither form nor shape form, the respondent came up with "eye consciousness." They agreed on the correctness of this statement. Next subject.

The Tibet that the Chinese took over 25 years ago was a religious state in which prominent monastic figures were involved in the government. The Dalai Lama believes this is now outdated. "Our basic governmental policy was to help promote Buddhist teachings of compassionate thought, honesty, decency. These are still useful. But monks must also work more actively in society; all cannot be scholars. Some should serve in practical ways."

With the new government in China following Mao's death came somewhat better days for Tibet. Refugees may return to visit their families. Some monasteries are being rebuilt. Schools may now teach the Tibetan language; more Tibetans are being brought into positions in government.

The Dalai Lama has been invited to return, for a visit or to stay. He began to test the water in 1979 by sending in delegations. Three have gone so far. Given freedom to travel about, they have visited regions where for more than 20 years there had been no contact, no news from even the closest relatives in exile. Uncut film, made by the first delegation, shows masses of Tibetans struggling to be near His Holiness' representatives, their sheer pressure breaking down barriers. They poured past guards, sobbing, falling to the ground, making over and over the traditional gestures of respect. I quickly forgot the amateur quality of the camera work, the subject matter was so overwhelming.

Although he speaks of his interest in returning, the Dalai Lama is cautious. The Panchen Lama, who was second to him in the pre-1959 religious hierarchy, initially bowed to the Chinese but later resisted and was taken off to China. He returned to Tibet for a visit in 1982 and was allowed to make a speech. But, said the Dalai Lama, the Chinese rewrote it three times before permitting him to deliver it. "And so it was not he speaking. Tibetans who have returned to Tibet say I should not go unless I am very sure I would have a free hand. Only then could I do something for my country from within its borders. My representatives say the situation is still very political. If things improve, I would like to make a short visit around 1985. The main condition is that my return give satisfaction to the Tibetan people. I am their spokesman; my return is for them to decide. They are my boss."

Tantric Buddhism's great Nyingmapa saint, Kyentse Rinpoche, sometimes gives teachings to Dalai Lama.

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Metropolitan Museum of Art, New York

Severin Roesen's *Still Life: Flowers and Fruit*, painted about 1855, is a veritable feast for the eyes.

It is also an exact representation, in minute detail, of growing things—a scientific painting.

By Henry Mitchell

Glorious flowers as they burgeoned in American art

In good time for those first green signs of spring, the Whitney Museum offers a 300-year growth of flowers on canvas

A good bit more than the vision of the eye enters into any floral painting, but even the eye is astonishing in what it sees and fails to see, as everybody knows who has heard an event described by various witnesses trying to be accurate.

The exhibit of paintings at the Whitney Museum of American Art in New York on view from March 1 through May 20 is a grand assemblage of American art and is rewarding just in its variety of flowers, but a major point of the show is to reflect changing views of nature. Artists range from Bartram and Audubon through Heade and La Farge to O'Keeffe and Krasner. Some paintings are literal, some impressionistic, some abstract, all of them reflecting the currents of their day. (Alfred A. Knopf is publishing *Reflections of Nature: Flowers in American Art* by Ella M. Foshay, who is also curator of the show.)

In the Whitney show the Roesen still life of flowers and fruit (c. 1855) is an example of a painting that hints of earlier centuries. One thinks of the great floral pieces of the Low Countries, with an infinitude of garden flowers from spring, summer and fall, all brought together in one vase. Yet few would confuse the Roesen with older work. It is more sentimental than baroque, and a self-conscious pathos inheres in it.

Just here it is well to insist on the obvious, that paintings are not literary essays. If the painter could sum up his meaning in a paragraph, then he has gone to a lot of needless labor and used up a lot of good clean rags to say it on canvas.

A painted flowering in time for spring

There is a painting of William Bartram, the great American naturalist and plant explorer, to give an example, done by Charles Willson Peale. The odd thing about it is that Bartram is shown with a spray of the common jasmine. Common everywhere except the United States, and known here as an exotic of gardens in New Orleans and Charleston.

Surely Bartram would never have been painted with a flower he had no connection with? Surely it is the Carolina jasmine? Or a pale form of the native cross vine? Not at all. It is the jasmine of Italy, and there is probably some good reason for it, but one does not know it.

Whatever the origins of this apparently incongruous detail, the painting must stand on its merits as a portrait, and the detail of the jasmine becomes a minor puzzle.

John James Audubon, the American naturalist, is chiefly celebrated for his paintings of birds, widely distributed through hand-colored engravings, as in the beautiful series by Havell. One of these is the *Ruby throated Humming bird*, alive with brilliant portraits of this most elegant of American small birds. The title, in very small script, barely mentions the American trumpet vine, although the vine occupies a good bit more of the space than the birds, and its color is at least as gorgeous. Audubon might have called it *Ruby throated Humming birds among Flowers of the Trumpet Vine, Whither They Commonly Flock Seeking Nectar.* This is not a bird portrait such as a painter might make from a set of skins in a museum. It is an ecological picture, showing the bird in action in one of its favorite feeding grounds.

It would be rash to say that in the 1820s a fit of ecological enthusiasm descended on American painters. What happened here is that Audubon wished the viewer to see the bird in its natural habitat. Not every painter, after all, knew a trumpet vine from a viola d'amore, and Audubon, who had spent endless hours among birds and plants in the wild, saw the bird and the habitat together. Anybody might, but hardly anybody did. As in the case of the birds, the flowers could not have been painted merely from museum specimens. Only a painter who had seen these flowers many times in their natural living growth could have captured so well the peculiar downward swing of the flowering branch and the odd, lovely, irregular combination of buds and open blooms.

A good bit is said about naturalism and romanticism and realism in floral painting, as if it only became possible in the late 18th and 19th centuries, yet every lover of flower pieces is fully aware that long before Christ the Egyptians painted grapevines and herbs and fishes and ducks and palm trees almost as "truthfully" as a color camera, and one may find quinces and roses from the reign of Augustus looking good enough to smell or eat, and there are medieval irises and columbines and lilies that would do well enough to illustrate a seedsman's commercial catalog.

Another trap for the unwary—the Whitney show makes this obvious—is the common failure to regard paintings as part of the long tradition of painting as a skill. Since each painting is a unique esthetic event, the pleased viewer may forget the painting is also related to other paintings and has a lineage.

The influence of the painter's society on his work is hard to overestimate. It is probable that some ancient artists have been overpraised for their sensitivity and mastery when much of the credit is owed to the iron constraints within which they worked. Art of high quality may result from endless practice in a restricted field, in other words, and beautiful things may be produced by those who have been painfully taught, as well as by those who have soared on superhuman wings.

American flora delighted and fascinated Europeans, and while importations of garden plants into that continent did not get well under way until the 17th and 18th centuries, the New World had begun to be thought of as a natural paradise from the 16th century on. Gardens as we know them hardly existed in England before the reign of Henry VIII, and even then there were extremely few flowers to be seen once the roses ended in June and the pinks in July. Such American plants as the great Southern magnolia, *M. grandiflora* (which, however, only arrived in Europe in the 18th century), and such brilliant summer-blooming wild flowers as the lobelias and monardas were certain to strike even the most casual eye.

A staff writer for the Washington Post, *Henry Mitchell also writes the paper's* Earthman *column.*

Shelburne Museum, Vermont

The New-York Historical Society

Elegant and minuscule *Ruby throated Humming bird* in leafy setting was painted by Audubon in 1825.

Martin Johnson Heade's *Hummingbird with a White Orchid* (left), a mature work, was painted in 1870s.

Naturalist as well as artist, Heade painted dramatic views of his subjects, as in his *Giant Magnolias*, c. 1885-95, which, although precise in observation of the flowers, is also a tour de force.

R. W. Norton Art Gallery, Shreveport

A painted flowering in time for spring

Philadelphia Museum of Art

Charles Sheeler's stylized juxtaposition of cactus and photographic equipment was painted in 1941.

In the more than 100 paintings of the Whitney show, not all depict flowers of the United States. Martin Johnson Heade, whose *Hummingbird with a White Orchid* was painted in the 1870s, fell in love with tropical orchids and painted them with flair.

It was thought likely that Heade was drawn to orchids as an outgrowth of his passion for hummingbirds. He once wrote that "from early boyhood I have been almost a monomaniac on hummingbirds." Explicit in his work is the conviction that the natural world is beautiful enough in itself not to require more than a faithful rendering and artful grouping by the artist. He visited Brazil in 1863 to study hummingbirds, and proposed a book on the subject.

The great waxy blooms of *Giant Magnolias*, painted around 1890, have a monumental nobility and repose, as if they were cult objects or possessed of some power beyond vegetable life, and again suggest Heade's reverence for the flower as something near sacred.

It is a shock—not an unpleasant one, however—to turn from Heade to Lee Krasner's painting of the milkweed, done in 1955. It is hardly a milkweed as the eye sees it, and one might say at first it could as easily have been called anything else. It is a collage—oil, paper and canvas. The thrusting points suggest the pulse of organic life rather than, say, the harmonies of a steel bridge. The milkweed for this painter, obviously, was the point of departure for a subconscious meditation or reverie on the beautiful weed.

In actual fact, Lee Krasner was fully familiar with the milkweed and had observed it for years, but felt no urge to reproduce its natural beauty as seen by the eye on a jaunt through a meadow or along a railway embankment. A literal portrait would have limited and blocked the very subconscious reading she wished to present. The role of the subconscious, even in realistic paintings, can hardly be overestimated.

Brooding roses, mysterious flowers

John La Farge's luminous *Wild Roses and Water Lily*, painted around 1883, depicts the fully recognizable flowers in a garden or in the wild; it is impossible to say. The roses, which in nature are much smaller than the water lily, are here shown relatively oversize. They brood over the mysterious aquatic flower, but it is from the water and its flower that the light radiates. On a realistic level, one can imagine wandering by a natural pond, pushing aside a wild rose and seeing for the first time the water lily by the shore. On symbolic levels, one may explore at length without contradiction by the information of the painting.

From this lushness one may turn to Charles Sheeler's cactus in its antiseptic setting, painted in 1931. It might have been painted on a barren hillside beneath

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Georgia O'Keeffe was intrigued by black iris, searched in the New York markets for it, painted this in 1926.

Lee Krasner's *Milkweed*, 1955, does not attempt precise representation, is intent on esthetic feeling.

a vast sky, but instead is shown in a pot under floodlights. The table surface is sterile and glassy, and the setting might as easily be a laboratory as a photographer's workroom. The abstract shapes about the plant, the cords and metal shades of the lights, are clearly of the modern world, in the center of which the primitive cactus not only flourishes but burgeons. Polished manufactured things without sense here focus on a living sensing plant, and not one that is graced with half the spectrum and a wonderland of floral structure, but a plant that symbolizes, and is the product of, the harshest sort of environment. Its swollen structure consists mainly of leaves, modified to absorb the rare rainfalls of its habitat.

But it is as different from the polished tabletop and the electrical cords as an orchid would be. In its stems it shares fully with the orchid or the rose the wonder of life, and like them has achieved its shape, its function and its very nature from the pressure of cosmic forces beyond its control. Every element in the picture is chosen to contrast with the plant. One has no doubt, looking at this Sheeler, that the plant will outlive a thousand laboratories, that what is natural will last.

Everyone should try painting a flower, if for no better reason than to develop a decent respect for those who do it well. But it is easier to be accurate than to make the thing live on canvas or paper. Many a rose or iris will persuade the amateur to lay down his brushes forever.

It is remarkable, among painters so gifted and aware, that they all bear the mark of their own period in time. Enough has already been said of the dangers of drawing broad conclusions about romanticism and other auras, to the neglect of the painter's own will and circumstances, yet it must be true that one's notion of a rose is touched by the common knowledge of the day.

One painter might know only the surface of a flower, another might delight in its functional parts, and yet another might be aware of the whirling electrons, the transience of matter and its relationship to energy. Depending on his understanding, he will paint the flower one way or another.

Since Darwin's exertions of the 19th century, virtu-

Collection of Dr. Irwin Goldstein

Charles Burchfield's joyous *Dandelion Seed Heads and the Moon*, watercolor, was painted in 1960s.

ally everybody sees flowers and all other life as mutable and inconstant. In the short span of human life a rose remains a rose, but no painter since Darwin is unaware of the long road the rose has come or the remote horizon toward which it moves. This may not change the painter's brushstroke or palette, but it certainly alters the mind with which he perceives.

Shakespeare spoke of forces "no stronger than a flower," and if one thinks of flowers as ephemeral, one may paint them differently from an artist who wonders how much violence is locked up in all those atoms, and what force inheres in a creature that without help from gardeners has survived in a competitive world since before the first man appeared on Earth.

If a painter sees all life as related, he will think differently and perhaps paint differently from one who sees a blackberry here, a gentian there, a robin yonder and an elephant in the distance, sensing no connection whatever between them.

What will the viewer make of Georgia O'Keeffe's *Black Iris*, beyond the observation that the sculptors of Karnak under Thutmose III produced an iris that "looks more like an iris." The Egyptian was hired to celebrate the glory of his pharaoh and the wonders brought back from a Syrian expedition, and to this end produced an almost photographic record in stone. He did his job very well. Miss O'Keeffe, who possibly felt no requirement to celebrate Calvin Coolidge, the ruler under whom she painted the work in 1926 and a man who never brought back irises from anywhere, painted from insightful hunches rather than for a monument.

No iris looks like hers. The most conspicuous feature of the bloom, viewed in natural light in a garden, is the upward swirl of the three crowning petals, and these the artist not only fails to show, but declines to do more than hint at. The center of her picture's weight is the interior of the iris, specifically the style branches which are part of the female organ of the flower, and these are scarcely visible when the flower is seen casually outdoors.

The picture very likely would have baffled an 18th-century naturalist. But we are used to visualizing structure even if we do not see it. It does not frighten us that different waves of light produce effects undreamed of in past ages. Were we to take the petals and render them transparent and vaporous, we would see pretty much what O'Keeffe shows in her painting.

We also have little trouble seeing a meaning, that the sex of the flower is at least as important as the surface petals, or that the soaring triangles of the flower do not exist without the more solid and weighty base that we rarely see.

It could be argued, maybe, that the female element of the flower, so rarely noticed outdoors, is a paradigm for the role of the feminine in human life: often suppressed but entirely basic, and too often ignored or obscured. In any case, the O'Keeffe iris raises questions of structure, of reality, that hardly arise when one admires the Roesen still life of flowers and fruit.

In a new age (1926 was not all that long ago) a new iris all but demands the viewer to ask why it is painted this way, a way no camera will show it or even any X ray. Something of the mystery of the flower is preserved, along with ample allusions to its surface glory.

To ask the viewer to think what the meaning may be, even beyond the formal patterning and design, is a function of fine art that is not always shared by fine crafts, however luxurious. To paint it new, to look at it new, to ask new riddles about the flower and about life, is no slight achievement in a painting of a bloom.

John La Farge was fascinated by water lilies and made *Wild Roses and Water Lily* between 1882 and 1885.

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O U S A N D

Immutable and beloved D'Oyly Carte *Mikado*, in a 1921 illustration, shows (from left): Three Little Maids including Yum-Yum; Nanki-Poo as wandering minstrel; Lord High Executioner with his snickersnee.

Next come Pooh-Bah, the Lord High Everything Else; a thinnish Mikado; and Katisha, a jealous contralto.

As PBS Mikado, CBS private eye Cannon (William Conrad) tries to "let the punishment fit the crime."

By Israel Shenker

Lately of London, Gilbert and Sullivan make a TV treat

The new series on PBS is not entirely yum-yummy, but the old masters revisited still add up to a matchless musical pair

When the notion of financing a Gilbert and Sullivan television series hit him, London's George Walker made the wires hum. "Sing me some of the tunes," he said over the phone to prospective producers. "They hardly remembered any," he recalls. "Then somebody told me there's a girl in New York who's won two Emmys—two more since then—who's a television producer. I phoned her. She knew every song—sang them over the telephone."

Trial by Jury judge (Frankie Howerd) settled case by deciding to marry the jilted girl himself.

"You'd better get on the plane and come over here," Walker said to Judith De Paul.

"You'd better send me a ticket," said Judith De Paul to Walker.

That was the kind of counterpunching he was familiar with. Back in 1951 George Walker was Britain's amateur light-heavyweight boxing champion, and eventually, after launching into business, he took undisputed title as managing director of Brent Walker, a company which calls itself a leisure group and is quoted on London's stock exchange. "I have three garages, about 15 taxi companies, five casinos, two golf courses, two squash clubs, the dog track at Hackney and a shopping complex on Oxford Street," says Walker, barely winded. "We built the El Salam Hotel in Cairo—in one year, Korean labor, 328 rooms—and sold it off in 1981. We're an enterprising group—it's not an investment for widows and orphans."

But when he heard that the D'Oyly Carte company was in trouble after 103 years of producing Gilbert and Sullivan on the stage, he took a paternal interest—and gave them money, too. D'Oyly Carte had asked England's Arts Council for a grant, but a review board unkindly compared the company to "a splendid old actress well past her prime, waddling away into the distance to a well-deserved and peaceful death." But finally, in February 1982, D'Oyly Carte, beloved but fiscally feeble, gave its last performance.

Walker sent no flowers. Instead he sent for De Paul. "Show business is often a lot of talk and very little action," she has remarked. "But George sent me the ticket the day after he called. I came the day after that, and we were off and running. The first fruits of the De Paul-Walker collaboration, *The Yeomen of the Guard*, can be savored by American audiences March 21 on PBS stations around the country. It will be followed by *The Gondoliers* (April 11), *Cox and Box* and *Trial by Jury* (May 2) and *The Mikado* (June 6).

"A bread-and-butter commercial producer"

De Paul went on the stage when she was seven years old, came off it 25 years later as a soprano soloist at the Metropolitan Opera, and became what she describes as "a bread-and-butter commercial producer." With her background in music she knew the score, and her libretto includes not only the hyperbolic strains indigenous to show business ("What we've done is so unusual and magnificent") but also the dulcet tones suitable to a Lord High Executioner ("I yell a lot").

For the updating of D'Oyly Carte she chose a variety of directors, prepared to give them their heads—on a plate, if they failed. Her assignment was to supervise one and all as they squeezed the familiar, not to say rigid, Gilbert and Sullivan staging into a TV format

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In TV *Yeomen of the Guard* (March 21), Beefeaters sing well in chorus, are most sumptuously arrayed.

In *Cox and Box*, Cox (Russell Smythe) and Box (John Fryatt) are finally reconciled under an umbrella.

Scene, unthinkable in D'Oyly Carte, has *Trial by Jury* bachelor (Ryland Davies) in bed—with wrong lady.

within budget and on time. That meant intensive rehearsals, only a week for videotaping each opera and no time at all for reviving the faint of heart. Her aim was to respect tradition, but to serve it up briskly engaging, artful but not arty. Exults De Paul, "We've taken the mothballs out of it."

Christopher Renshaw, who directed *Ruddigore*, realized that to be enjoyable for TV audiences the preposterous work had to be played seriously. How else could viewers swallow the hocus-pocus of ancestors tripping the light fantastic by coming right out of their portraits into life? "You have to have faith in the situations, however silly they are, and play them up to the hilt," says Renshaw. "The D'Oyly Carte had an immense tradition behind it—in its own way it was quite stylized. Our production needed a freedom that the D'Oyly Carte wasn't able to give it."

Since *Patience* satirizes the Aesthetic movement and Oscar Wilde types, director John Cox, general administrator of the Scottish Opera, introduced numerous visual references: "In television one could dwell on them in detail—the sunflower, the lily, the peacock feather, the looser clothing for women, the languid line. I insisted on certain things, and I didn't want any dubious stars imported into the show just to sell it in America."

"With people like Cruikshank drawings"

To play the Mikado (but look like a sumo wrestler), De Paul did, however, import William Conrad, television's private investigator Cannon, Joel (*Cabaret*) Grey to be Jack Point in *Yeomen of the Guard*, and Peter Marshall, ex-host of TV's *Hollywood Squares*, as Captain Corcoran in *HMS Pinafore*. When De Paul found that Britain's costumiers did not have enough sailor suits for the sisters and the cousins and the aunts in *Pinafore*, she settled for women's 1890 garb instead. *Yeomen* was done in Charles I apparel. *The Sorcerer* was set, circa 1830, in what costume coordinator Jenny Beavan describes as "a Dickensian, country-house-party look, with people like Cruikshank drawings." "*The Gondoliers* looks like paintings by Canaletto," says choreographer Terry Gilbert. "A fantasy of Victorian Gothic for *Ruddigore*. And *Princess Ida* was Pre-Raphaelite."

Having more than $14 million to conjure with, De Paul opted for an acting style somewhere between naturalism and make-believe. Sometimes sets are solidly realistic, and sometimes flimsy and gaudily decorative. Makeup is laid on thicker than the BBC might have wished, but the American market is supposed to welcome war paint. The use of tape allowed intimate scenes and special effects impossible in the theater—an actor able to soar sans wires over the stage

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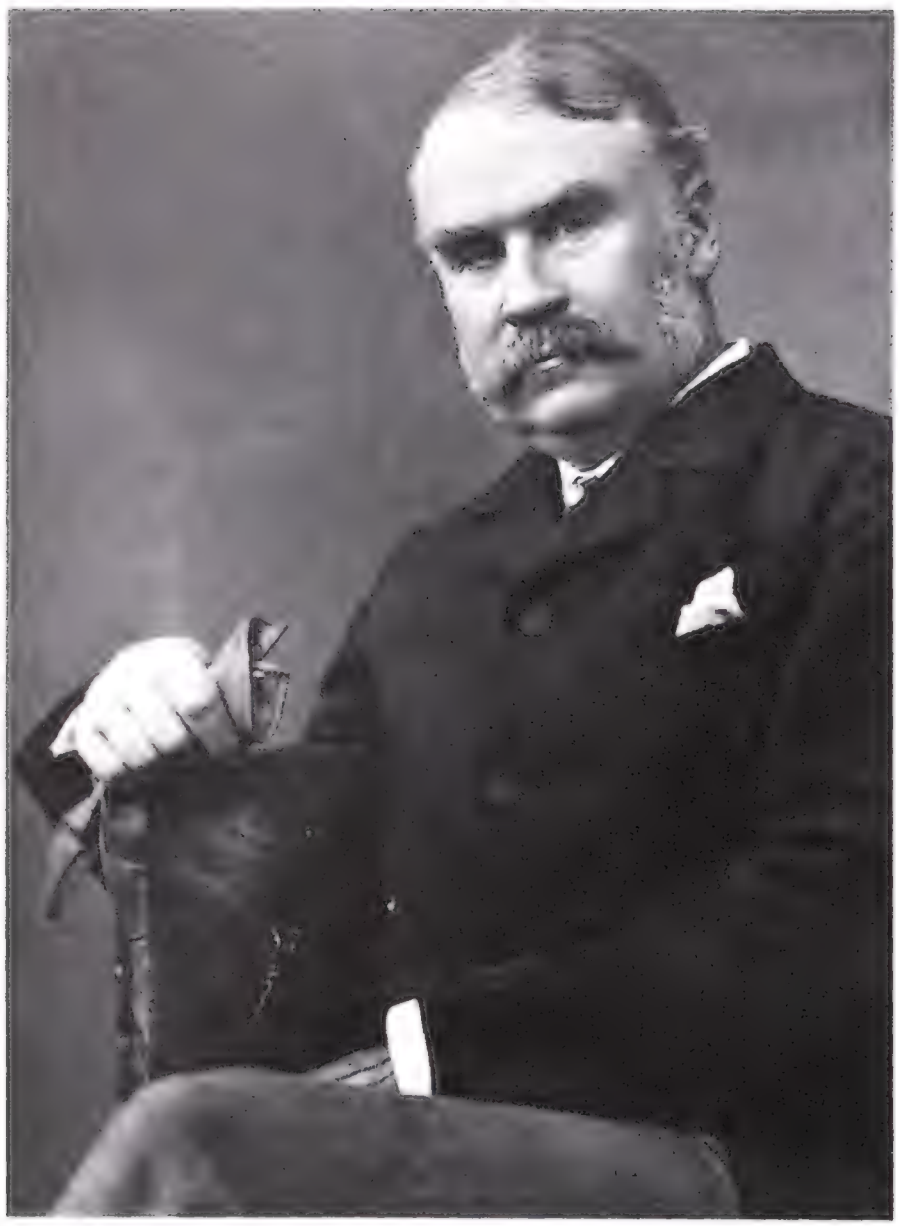

Acerbic librettist William Schwenck Gilbert had a tongue so sharp he feuded with practically everybody.

in *Ruddigore*, for instance, or to emerge from a pond drip-dry as Iolanthe does. The London Symphony Orchestra recorded the music, and then, during taping, the principals sang their parts while the recording played. Chorus lyrics were prerecorded off-camera. This allowed Terry Gilbert to use people who could dance and do acrobatics instead of having to settle for heavy-footed singers. His video choruses mimed the words. Says Gilbert: "At least half of each show is choreographed or made *mouvementé*. Where scenes could be witty or amusing we've been able to make them dance and the camera dance. But we taped every single word and every note."

Gilbert's comic fancies trip forth delectably, rarely betraying a hint of age. Occasionally, as when Joel Grey's American accent in *Yeomen* contends with the English voices all about him, the words trip and fall, more incongruous than even Gilbert intended. With static stage conventions turned kinetic, the yeomen seem prepared to do a buck-and-wing if it will get the story moving.

In the theater, Gilbert and Sullivan's gondoliers seem beyond hailing distance. On TV, they appear close enough to shake by the outstretched palm. Lovers coo full-screen, and dancers cavort with an ardor that would have sent the D'Oyly Carters caroming into the wings for first aid.

Cox and Box is a renegade—admitted to the Gilbert and Sullivan canon though it predates (1866) their collaboration. Sullivan composed the tunes to a libretto adapted by F. C. Burnand, a sub-Gilbertian humorist. The one-act farce is usually played with only three actors, on a single set depicting a miserable rented room. On television, actors and locations have multiplied, and include character bit parts and fog-bound Victorian streets. *Trial by Jury*, played as companion to *Cox and Box*, has been padded out with pantomime of the principals primping at home for their appearance in court. Britain's enormously gifted Frankie Howerd plays the leering judge about as delightfully as any man could, now that Groucho Marx has moved to a higher jurisdiction.

Howerd also stars in *Pinafore* as First Lord of the Admiralty, and is never at sea in the role, either. By the time *The Mikado* puffs into sight, faithful viewers should be ready for Sullivan's Oriental caprices, Gilbert's disorienting fantasies, and television's rejuvenating spell. Nothing can prepare, however, for the introductions by Douglas Fairbanks jr., who does not know what to do with his hands or to make of his role —an unwitting parody of Alistair Cooke.

The original William Schwenck Gilbert bawled his first lyrics in 1836. He grew up in London—with time off for good behavior in France and Italy. He studied law but soon gave it up to become a reigning master of satire and nonsensical verse, of puns delirious and plots mysterious. Tall and fair-haired, with mutton-chop whiskers, he was prickly, disputatious, dictatorial, by nature choleric, by temperament unforgiving, witty, honorable, generous, but hardly ever generous to a fault. Diary entry for January 27, 1878: "Rainy night. Row with cabman—refused to take us—made him—paid him bare fare—abusive—gave him card—number 8630." March 11: "Row with cabman—took 6d [pence] away from him. He is going to summon me." Gilbert himself was forever threatening suit, and for good reasons: publishers cheated, managers failed to respect his wishes, actors changed his lines. Wrote G. K. Chesterton: "He would not permit anything really incongruous to mar the complete congruity of his own incongruity." When his watch departed from strict punctuality, Gilbert threatened to

Israel Shenker, a former New York Times *reporter and author of the recent* In the Footsteps of Johnson and Boswell, *writes often for* SMITHSONIAN.

sue its makers, and when a woman styling herself the Comtesse de Brémont wrote to request an interview, he asked for 20 guineas. She replied: "The Comtesse de Brémont . . . begs to say that she anticipates the pleasure of writing his obituary for nothing." Bang! A lawsuit. Gilbert produced lots of evidence about the dubiousness of her title and the authenticity of her indiscretions—then let her off without demanding reimbursement of his legal costs.

Arthur Seymour Sullivan was the other side of the coin, angelic of voice and temperament from the start in 1842. Son of the bandmaster at the Royal Military College, Sullivan displayed his talent early. He wrote his first anthem at age 13, at 20 became famous overnight with music for *The Tempest*, and went on to glory with "Onward, Christian Soldiers" and "The Lost Chord." Small and dark, all Irish charm and softness, ingratiating, diplomatic, gentle, sensitive, attractive to women, a lover of gambling, horse racing and high society, Sullivan hobnobbed with the Prince of Wales who became Edward VII—more familiarly known as Edward the Caresser.

A century of catchy tunes and comic hash

In 1871, temporarily putting Royal associations and lofty ambitions aside, Sullivan collaborated with Gilbert on *Thespis*, a two-act grotesquerie that had two acts too many. Four years went by, and then, undaunted, Richard D'Oyly Carte, an ambitious theater manager and impresario, asked Gilbert to write a one-act operetta that Sullivan could put to music. The result, *Trial by Jury*, became a huge popular success, in part because it had catchy tunes, in part because it made comic hash of both judge and jury.

Thereafter it was agreed to form the company that was to endure for more than a century, and Carte persuaded G&S to furnish him with a succession of light operas, hit after hit as it turned out. For stories and even verse, Gilbert cannibalized the *Bab Ballads* he had written for a humor magazine; Bab was his childhood nickname, an abbreviation of babby, or baby. Sullivan began with rhythm, often setting it down with dots and dashes before sketching out the music. *Sorcerer* cast its spell for six months, and then *Pinafore* sailed off on a record run. Its takeoff on the man who never went to sea and then became the Ruler of the Queen's Navee—bookseller W. H. Smith, a landlubber appointed First Lord of the Admiralty—led Prime Minister Disraeli to dub the honorable lord "Pinafore Smith." In America, where British copyrights were always good for a laugh, *Pinafore* became so popular that a newspaper reported "there are forty-two companies playing *Pinafore*. . . . Companies formed after 6 P.M. yesterday are not included."

Soulful composer Arthur Sullivan dreamed of greater things, finally wrote grand opera, with glum results.

Next came *The Pirates of Penzance*, with its spoof on timorous police and solemn duty and an army all at sea—commanded by "the very model of a modern Major-General" who, for military knowledge, though "plucky and adventury,/Has only been brought down to the beginning of the century." This time Gilbert and Sullivan and Carte took the precaution of putting on the first American performance themselves. *Patience* ran in London for a year and a half, and opened the Savoy Theatre—the first to have electric lighting both on and off the stage. Carte built the theater to accommodate the big audiences avid for what became known as the Savoy Operas.

With *Patience* apparently holding forth interminably at the Savoy, Sullivan went off cruising with the Duke of Edinburgh. They were guests of Denmark's King, Russia's Czar and Germany's future Kaiser, who greeted his guests by warbling the *Pinafore* line describing the apprenticeship of the Ruler of the Queen's Navee: "He polished up the handle of the big front door." Queen Victoria herself was a Sullivan

Richard D'Oyly Carte produced 14 of the G&S light operas.

American favorite, *HMS Pinafore* was travestied in Currier & Ives print.

fan, and sent him her husband's compositions to improve. Prince Albert was no doubt musically indebted to his German compatriots, and Sullivan figuratively polished up the Handel.

Iolanthe, satirizing politicians and peers, succeeded *Patience*, and then came *Princess Ida*, a takeoff on the "new woman." *Ida* ran for only nine months, and Gilbert and Sullivan considered that a failure. Sullivan was determined to flee topsy-turvydom and lightheaded plots and ridiculous comedy. He wanted warmth and romance and credibility, oratorios, symphonies and the grand opera that Victoria thought he should write. When Gilbert tried to get Sullivan to accept a plot about people who changed their natures by swallowing a lozenge, Sullivan jibbed.

Then Gilbert seized on the idea of a Japanese opera, an idea that emerged full-blown when, the story goes, a Japanese sword fell off the wall of his study (it eventually became the Lord High Executioner's snickersnee). *The Mikado* packed the Savoy for almost two years, bringing enormous amounts of cash and outlandish complications. The Lord Chamberlain banned a revival because a Japanese prince was about to visit England; presumably neither Lord Chamberlain nor prince would appreciate that the opera (including Ko-Ko, the Lord High Executioner, and Pooh-Bah, the Lord High Everything Else) really satirized the English, not the Japanese. A member of Parliament asked the Prime Minister whether, since Denmark was a friendly nation, *Hamlet* should be banned. Shakespeare, after all, portrays the Danish king as a fratricide.

After *Ruddigore*, which lasted a mere ten months, *Yeomen* and *Gondoliers* ran on and on, with disputes en route. "I can't stand it any longer," Sullivan wrote in his diary about what he termed "this slavery," adding, "Do they think me a barrel organ?" He objected not only because light opera wasn't important enough, but because, he wrote Gilbert, he felt himself playing second fiddle in the partnership, forever having to tailor his music to Gilbert's fancy. Gilbert expressed "amazement and regret." "You are an adept in your profession, and I am an adept in mine," he wrote Sullivan. "If we meet, it must be as master and master —not as master and servant."

Sullivan had a painful kidney disorder, and was forever on the brink of collapse. "Most people suffer and get well again," he complained. "I suffer and don't." Gilbert had gout, and characteristically gave his left foot the name of one hostile critic, his right foot the name of another. Gilbert was master of the crushing retort. When a new production was staged, it was Gilbert who dictated not only lines but staging—sets, costumes, lighting and acting, harrying his actors toward perfection so mercilessly that eventually one actor exploded: "Look here, sir, I will *not* be bullied. I know my lines." "That may be," Gilbert rejoined, "but you don't know mine." Offended by the regular weekend crush at Baker Street Station, he wrote: "Saturday afternoon, although occurring at regular and well-foreseen intervals, always takes this railway by surprise." Asked what he thought of plans for a San Francisco fair, he replied: "I view the proposal . . . with an equanimity bordering on indifference."

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The affair of the carpet was closer to home. For years, Gilbert and Sullivan and Carte had been financial partners, sharing mammoth profits. When Gilbert discovered that Carte had charged to partnership expenses the cost of a new carpet for the Savoy Theatre he was ready to tell it to the judge. Sullivan, ever allergic to distasteful business, sided with Carte and resented what he considered Gilbert's intemperateness. Gilbert was appalled at what he viewed as Sullivan's treachery, refusing free tickets for *Ivanhoe*, the grand opera Sullivan finally wrote.

The course of true loathing never runs smooth. After Gilbert and Sullivan had each tried his hand with other collaborators—in *The Mountebanks*, Gilbert liquefied his lozenge, but it was still difficult for audiences to swallow—the wonder team reunited to produce *Utopia Limited*. It was not the answer to a country's prayers, and neither was the final collaboration, *The Grand Duke*.

Sullivan had been knighted in 1883 and when in 1907 Gilbert got *his* knighthood, he characteristically called it "a tin-pot, twopenny-halfpenny sort of distinction." A woman friend asked if she should call him "Sir William." "Call me Bill," he suggested. "Very well, I will call you 'Sir Bill,' " she said, and he rejoined, "I'll do the billing if you do the cooing."

Sullivan never married, and died in 1900, hurried along by overwork. Gilbert, who was happily married, vituperated along in style for another 11 years, finally succumbing to a heart attack in the artificial lake on his own stately property, trying to save a girl who thought she was out of her depth.

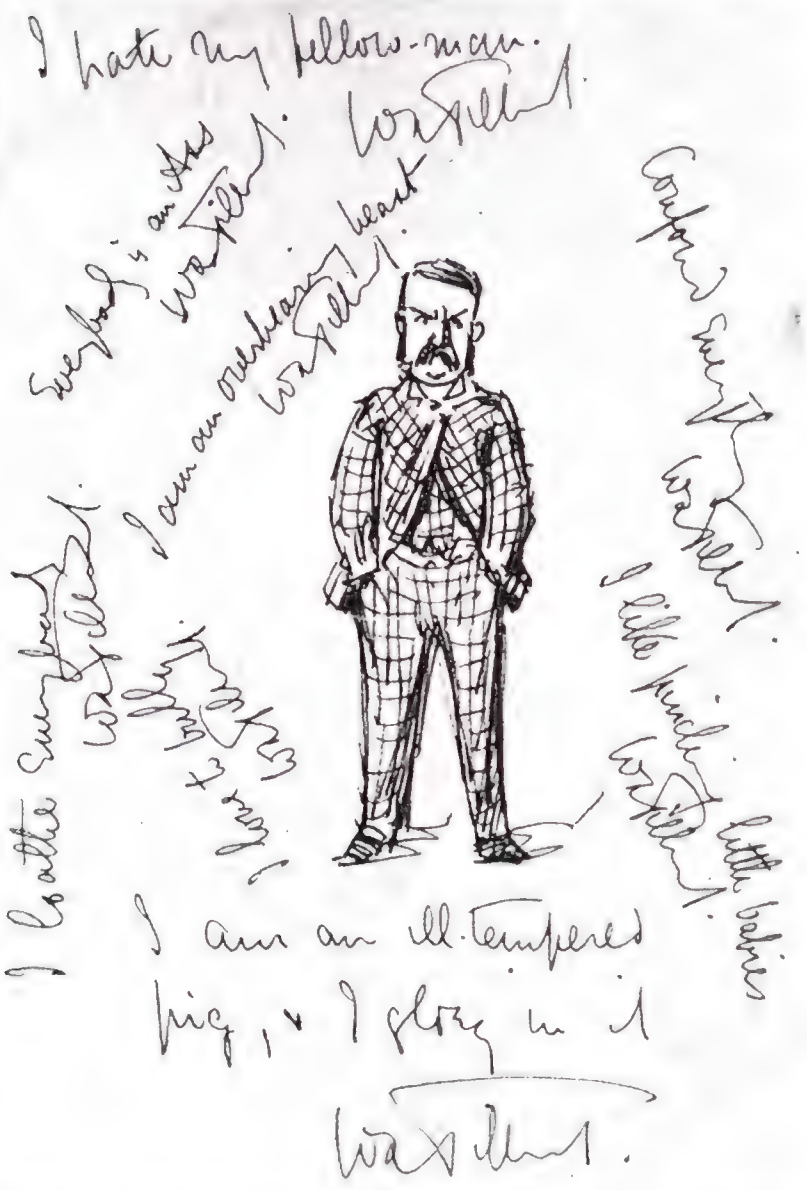
Long before the departure of the two great Savoyards, immortality was assured—tunes whistled, lines remembered. "The English Aristophanes," one critic called Gilbert, and Max Beerbohm wrote: "Mr. Gilbert is not a poet, as we understand the term; but there never was a more delicious versifier." "Twaddle" was what Gilbert called his own writing, "light flippery and amusing nonsense." Sullivan termed his contributions "iddle-iddle-um" music, but his tunes went wondrous well with Gilbertian mock-heroic fantasy.

Once the copyrights ran out, what had formerly ranked as piracy became respectable commerce. Just before World War II came a *Swing Mikado* and a *Hot Mikado*, and then, more recently, Joseph Papp's modernized version of *The Pirates of Penzance* in New York and London, with pirated copies of *his* pirates popping up to give him apoplexy.

"Their music has been pirated by so many songwriters," George Walker explains. "There are hundreds of Gilbert and Sullivan societies in the U.K., the U.S. and Australia." So he took an ad in *Variety* to announce plans for his television series.

"I'm used to going to America and knocking on doors and getting them slammed in my face," says Walker. "This was totally different. People were knocking on my door and. . . ." He stops short. No, he did not slam the door on prospective customers; he laid down terms. The BBC signed up, so did CBS Cable, as well as clients in Australia, Canada, South America and Europe. China, Taiwan and even Japan soon followed suit. The four shows on American TV this year will be followed by four more next year.

"This series will certainly outlive me," Walker says. "I'm 50, actually I'm 52—I keep lying to myself. I think I'll have most of the world wrapped up for video sales." He is really 54, but who can blame a man with five telephones on his desk and 12 operas on his tapes for indulging in a short count, now that the solo hum has swelled into a chorus of coin?



Pen-and-ink self-portrait by Gilbert came festooned with antisocial doodles like "I hate my fellow-man."

Trio of Little Maids, with Geraldine Ulmar (left) as Yum-Yum, adorned a New York City *Mikado* in 1886.

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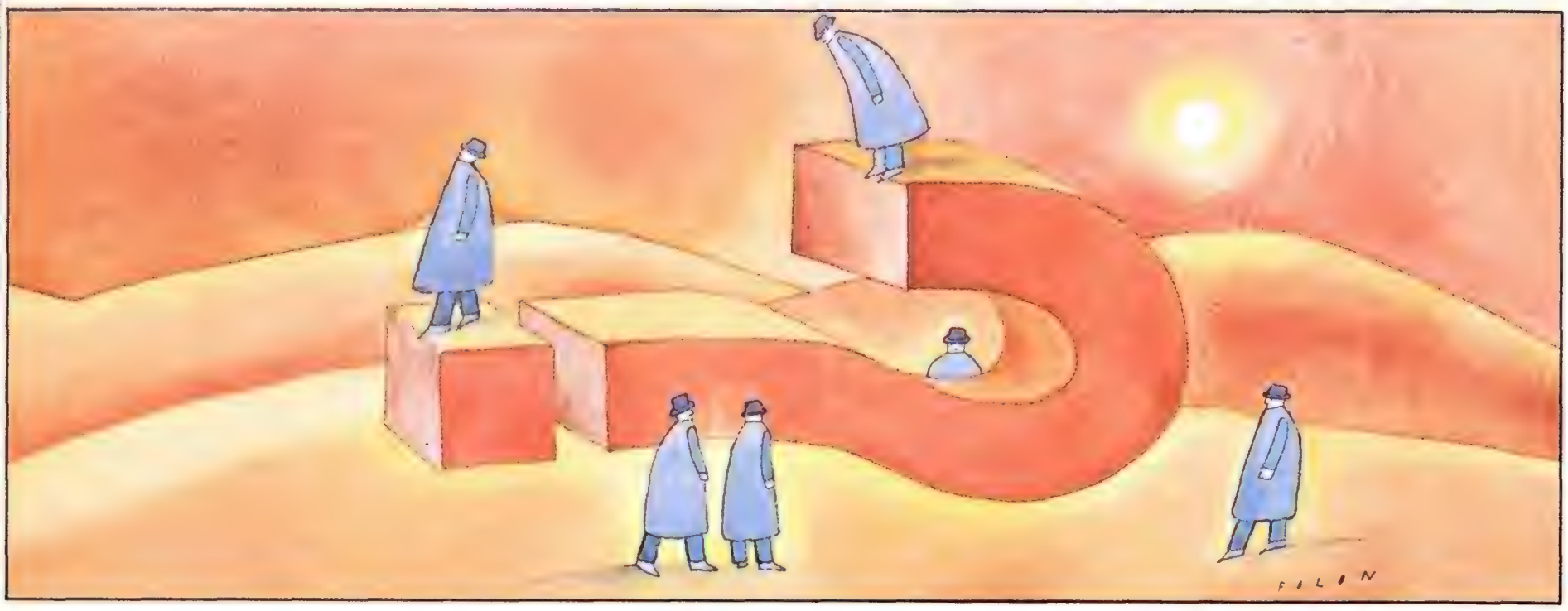

NUCLEAR WASTE DISPOSAL
Scientists have an answer

Scientists and engineers agree that high-level waste from nuclear-electric power plants can be disposed of without harming people or the environment. They favor placing the sealed-up waste deep within natural geologic formations that have been stable for millions of years.

In nuclear plants, the uranium fuel pellets that are used to generate energy accumulate a small percentage of highly radioactive byproducts called high-level waste.

A solid majority of scientists have concluded that the best way to dispose of this waste is sealing it in long-lasting canisters, which are then placed in mined repositories deep underground.

Scientists worldwide say disposal is practical and safe

Over 25 years of experience in managing nuclear waste have led to an international scientific consensus: The many natural and engineered barriers of a deep geologic repository will keep high-level waste safely isolated from our environment and our descendants. Countries pursuing this disposal method include West Germany, Canada, Switzerland, and Sweden.

The respected National Academy of Sciences and other eminent scientific bodies have reaffirmed that high-level nuclear waste can be disposed of thousands of feet underground, in geologic formations that have been stable for millions of years.

America's new law on nuclear waste

With this scientific consensus as background, Congress has passed and the President has signed into law the Nuclear Waste Policy Act of 1982.

The actual volume of high-level radioactive waste from nuclear power plants is small. The volume taken up by all the used uranium fuel produced to date by commercial nuclear power in this country is the same as the volume of a single tennis court about 45 feet deep.

It calls for lowering the sealed-up waste (in a glass- or ceramic-like form) about 2500 feet underground, into geologic formations such as granite, basalt, or salt.

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When he arrived at the McGreals' from a research laboratory, Arun Rangsi, a baby gibbon, was desperate and dangerous. With care and knowledge, Shirley McGreal transformed him into an affectionate animal.

By Patricia Curtis

If a gibbon bangs his head, it's best to bang yours, too

At her unusual sanctuary, Shirley McGreal shows that a good way to put animals out of their misery is to make them happy

Shirley McGreal is sitting on her living-room couch mothering a baby, who is nestled against her, taking a bottle. From time to time, he looks into her face and seeks affection by offering his fingers or toes to be kissed. He yawns and his eyelids droop. He is secure.

Though he behaves much like a human baby at times, he is in fact a four-year-old, golden-brown, white-handed gibbon named Arun Rangsi, a refugee from a cancer-research laboratory, where he had been labeled "retarded, unmanageable." He had been rejected by his mother in the laboratory when he was six days old, raised in an incubator with nothing more than a towel as a "surrogate mother," and had suffered pneumonia and dysentery, both highly fatal to gibbons. When he arrived at Shirley and John McGreal's two and a half years ago, he did nothing for several months but huddle in a corner, bang his head and bite. Though he weighed only four pounds, the McGreals had to wear padded clothing to handle him.

Shirley McGreal is not a collector of exotic pets. She is the founder and chairman of the International Primate Protection League (IPPL) and creator of a

Photographs by Linda Bartlett

In one of the large gibbon cages on the grounds of her home, McGreal visits a couple of lucky charges.

gibbon sanctuary on her property in Summerville, South Carolina. Among her other self-imposed duties is the rehabilitation of this particular little primate.

"At the suggestion of a psychiatrist friend, I read Barry Kaufman's book *Son-Rise*, about his autistic son," she says. "It helped me learn how to handle Arun Rangsi. John and I had to force ourselves into his world and not leave him alone in his isolation, no matter how hard he resisted. Often when he'd bang his head, I'd bang mine, too, just to get his attention and show him that someone else could do the same thing. We offered him toys constantly to get him to relate to objects. We tried to make eye contact with him at his own level, even getting down on the floor when necessary. We showed him himself in a mirror. One of us would grab him and the other stroke him for one, two and then three seconds, until he not only grew to tolerate being touched but to like it. Little by little, he acquired that crucial sense of self-worth.

"Some well-meaning people had suggested he should be put out of his misery. Well, we put him out of his misery—we made him happy."

Shirley McGreal is an animated woman of perhaps 40, with blondish hair, an open smile and an indefatigable dedication to her work. She was born in Cheshire, England, and attended the University of London. While on an English Speaking Union fellowship at the University of Illinois, she met her husband, John, an engineer. The couple later lived overseas for several years.

"An idea whose time had come"

McGreal traces her dedication to animal-protection work to a specific, profoundly moving experience. It happened in Thailand. "One day at the airport in Bangkok," she says, "I saw some little monkeys who had just been captured and were to be shipped to zoos and medical laboratories. They were crammed into a filthy crate, dazed, miserable, utterly bewildered. I can still remember the look they gave me. I started reading articles and books and writing to everybody I'd ever heard of who knew anything about primates. The response I got was tremendous. I discovered that an international primate protection league was truly an idea whose time had come."

Today, ten years later, the league's advisory board includes many of the world's leading primate authorities—names like Jane Goodall, William McGrew, Colin Groves and Geza Teleki. Its membership is about 2,500 worldwide, with field representatives in 22 countries. It works to block the illegal trade in primates in countries of origin such as Thailand and Zaire, and "laundry" countries such as Belgium. In January of this year Belgium became a party to the

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Helper Kathy Crawford grooms Toong, a female white-cheeked gibbon, who lovingly reciprocates.

Toong, nine, who was brought out of Vietnam by a serviceman, awaits a mate at the McGreal sanctuary.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Treaty, and it is hoped that this act will reduce the illegal primate trade in that country.

IPPL has also helped raise funds for Dian Fossey's antipoaching patrols in the mountain-gorilla habitat of Rwanda. It investigates cruelty cases, helps finance chimpanzee-rehabilitation projects in the field such as those of Stella Brewer and of Janis Carter (SMITHSONIAN, April 1981), and works to improve the conditions of primates in zoos and laboratories. The crucial research of IPPL has been largely instrumental in persuading a number of countries to ban the export of indigenous primates. The export of gibbons, which are in danger of extinction, is banned everywhere; unfortunately, poachers and smugglers still manage to do business.

Shirley McGreal's tender patience with her own animals is translated into a compulsive tenacity in trying to accomplish the work of IPPL. She travels the United States and other parts of the world to meetings of wildlife and animal-protection groups, always at her own expense. The only paid employee of the organization is a dedicated young part-time biology student, Kathy Crawford (above), who helps with the office work and the care of the animals.

"We are in business to protect primates," McGreal explains. "We judge each incident or situation from the point of view of the animal or animals in question: 'What would I want my human friends to do for me?' We make some mistakes that way, but not many."

She has proved a friend indeed to the eight gibbons for whom she set up her haven in rural South Carolina. Eight gibbons don't sound like many, but when you consider that they are an endangered species, that there are probably fewer than 500 in the entire United States, and that because they are expensive to maintain and need a great deal of space, not many zoos can afford to exhibit them properly—then eight gibbons in your backyard are a lot.

Gibbons are surely one of nature's marvels. They are lesser apes, not monkeys. With arms and legs fully extended, adults can measure five feet in height, yet they rarely weigh more than 30 pounds. It is in part the elegant ratio of body weight to length and strength of limb that makes them unique acrobats. Compared to gibbons, chimpanzees seem heavy and awkward, monkeys simply frenetic, and human athletes musclebound and slow.

A gibbon is frequently a study in weightless, fluid motion. A gibbon swinging on a trapeze, twirling around a bar and hurling itself to the ground to land like a feather is breathtaking to watch, but most riveting to an observer is a progressive swinging by the arms called brachiation. A gibbon brachiating moves rhythmically, fast or leisurely, hand over hand from one horizontal support to another, arms fully extended, legs bent at the knee and relaxed—a stunning display of grace.

Patricia Curtis last wrote about animal shelters in the September 1982 issue of SMITHSONIAN.

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A human athlete watching a gibbon walk, however, can regain a measure of self-respect. The animal has a comical, lurching, bowlegged gait like that of a toddler whose diaper is flapping in the way.

At the McGreals', four adult gibbons, former pets brought from Thailand—Durga, Sapphire, Toong and Brownie—live in two huge outdoor cages designed and built by John, who is a willing collaborator in the hands-on care of the animals.

Four other younger gibbons—Arun Rangsi (Rising Sun of Dawn), Metta (Mercy), Karuna (Loving Kindness) and Shanti (Peace)—are refugees from research laboratories that for one reason or another wanted to place them in new homes. These animals share two large outdoor cages and their own heated house. Shanti, though she measures nearly five feet with arms extended, had been kept in a cage three by three by four feet and could not stand up, climb or swing herself when she arrived. "Shanti had been in a solitary cage for two years and was very thin and shy," McGreal explains. "We gave her lots of attention, groomed her and expanded her diet."

The eight gibbons are not the only animals in the McGreal household. Three extremely territorial and protective Thai dogs continually patrol the large property. In addition, there are six Asian small-clawed otters—funny, friendly little beasts who come when called and follow their owners about. They live in big, outdoor, fenced enclosures, each with its own swimming hole.

John McGreal tells a story about how he and his wife acquired the first two otters, Otto and Potter: "We were in the market in Bangkok one weekend—the slave market, I called it, for you could buy anything there from a baby elephant to a parrot, all of them half dead. Shirley spotted three baby otters that were expiring in the blazing sun, and asked the animal dealer to give them some water. He refused. Shirley persisted. A large crowd gathered, fascinated by this foreign woman who not only spoke fluent Thai [Shirley can get along in 12 languages] but was so passionately concerned about the animals' welfare.

"I was a little worried, because you never know what a crowd will do, but it soon became apparent that this one was squarely on Shirley's side. The dealer was getting more and more angry and defensive. Suddenly, one of the baby otters died. Well, the crowd went wild. The dealer, realizing the people might tear him apart, picked up the remaining two and thrust them into Shirley's hands.

"We had to learn fast how to take care of otters. We fed them fish milk shakes and introduced them to water and swimming. Here they are, 12 years later—and 12 is a ripe old age for otters."

Shirley McGreal comes in with a load of mail from IPPL's post-office box in town. A tourist in Taiwan wants IPPL to investigate a storekeeper who keeps an orangutan, its face painted blue, tied up in front of his shop. There's a letter from Dao van Tiên of the University of Hanoi, who is doing studies of remnant populations of gibbons and other primates that survived the Vietnam War. "The defoliation of the forests nearly extinguished many species," comments IPPL's chairman. "We're the only wildlife group that we know of that has a representative in Vietnam. I wish some action could be taken there to protect the few gibbon populations that are struggling to come back."

She is ecstatic over a letter from Mohammed Khan bin Momin Khan, Director General for Wildlife and National Parks, Peninsular Malaysia, giving his opinion on the caging of Malaysian monkeys (crab-eating and pig-tailed macaques). McGreal put the letter to good use in her testimony at hearings of the Institute of Laboratory Animal Resources, a branch of the National Research Council, on the revision of its official guidelines for the care and use of laboratory animals. The IPPL made several specific requests: for example, it wants the institute to recommend larger cages for primates, with outdoor and varied enclosures, and to recommend allowing these social animals to live in groups rather than singly.

It is not easy to budge the vast laboratory research community into changing its traditional ways of housing animals, but Shirley McGreal keeps trying, patiently and persistently. As a laboratory-animal researcher once remarked with grudging admiration: "How can just one person cause so much trouble?"

Twelve years ago McGreal found Potter the otter in a Bangkok market and raised him on fish milk shakes.

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A secret recipe produced spaghetti Neapolitan, which sells, complete with floating utensils, for $400.

By Carol Simons

Costly cuisine, but it has a long shelf life

Mmm! Try sinking your teeth into these succulent creations—plates of Italian pasta, juicy oranges, even a Big Mac with fries

The prices are for real, but the food is fake

In a country where imitation is an art, where stunted trees look big and sand is raked to look like waves, where everything—including reheeled shoes—is attractively wrapped, why should anyone be surprised when the hot dog in the window turns out to be plastic? Not only the hot dog but the roll, the green salad, the hamburger and even its tiny blob of ketchup. Fake food is a reality in Japan, a surprising phenomenon that brings relief to the famished foreigner who suddenly realizes that ordering a meal is possible even for the linguistically lame. All he has to do is point.

The system also assures him of what extras will come on his pizza (mushrooms, onions and, in Japan, corn) and just how many peach slices will decorate his sundae (three). Fake food is fun, too: everyone smiles when they first see the noodles that actually stand up, supporting a fork and a spoon in midair. For many Westerners impressed by this display of antigravity, the "floating fork" has become a symbol for spaghetti.

You can order "floating fork" Neapolitan in thousands of Japanese restaurants for $3 or $4 a plate. Or you can buy a plastic version for just over $20 in Kappabashi, Tokyo's center for kitchen and restaurant supplies. In fact, in Kappabashi you can buy anything fake, from soup, for $25, to nuts, for $5. (If you want to buy "museum-quality" meals made for gallery exhibition, which includes most of the food shown on these pages, you must pay much more.)

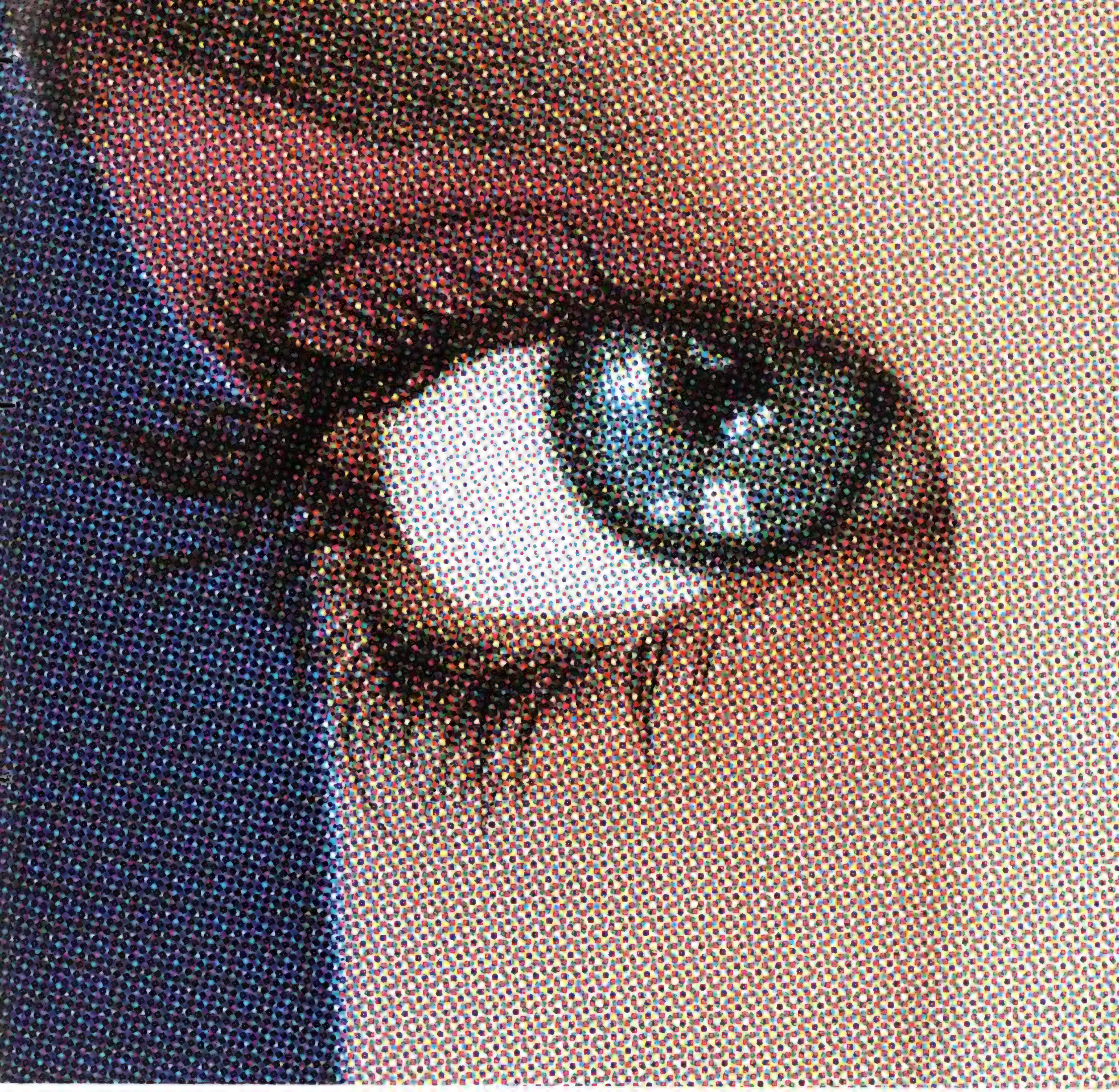
But fake foods are not meant to be souvenirs. To the millions of Japanese who tread sidewalks and back lanes every day in the traditional pastime of window shopping for something to eat, the pizza and floating fork represent one thing only—the menu. And the menu is usually a long-term affair. Most restaurants change their window displays only a few times a year, adding an egg roll or subtracting an omelet.

Not all restaurants display fake food. In fact the more expensive restaurants wouldn't think of it. But for the thousands of restaurants, snack bars, noodle shops and coffeehouses lucky enough to have a slice of window on the world, and for the thousands more in arcades and department stores, fake-food displays are the number one attraction. Diners gather around to compare casseroles, sushi and sundaes, and the prices marked alongside each dish.

Fish-painting expert Minoru Iwasaki, head of his family's fake-food firm, dabs at a plastic rockfish.

The origins of the fake-food industry in Japan are somewhat murky, but the idea began in the 1920s with the introduction of Western food. The cautious Japanese populace wanted to know beforehand what it would be eating. The image of an omelet with ketchup, flanked by a price, removed the chance of embarrassment and said "Welcome." After World War II the custom of using fake food became set.

According to Yasuaki Iwasaki, assistant manager at Iwasaki Co., Ltd., the largest fake-food manufacturer in Japan, it is competition among Japan's many restaurants that keeps food samples in the windows. "People choose by looking in the windows," he says, "and because so many restaurants serve similar food, the owners are constantly trying to make their food



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To make a head of lettuce: place a ladleful of wax into a bowl of warm water to harden it.

Then pull sheet of warm wax out of water, artfully crinkling it into a rounded "leaf" of lettuce.

Wrap successive leaves around the growing head of lettuce. When cooled, slice it into wedges.

look better than the food that's on display next door."

Appearance is important. Many a foreigner is wide-eyed when his ham steak is set before him with three carrot sticks, 11 peas and a pineapple slice arranged in a pattern—and his neighbor's platter arrives looking exactly the same.

Fake-food production represents a combination of art and science with a bit of magic thrown in. Years ago most of the food was made from wax, but today polyvinyl chloride, better known as PVC or plastic, has taken over. Plastic food can last for years, but wax is cheaper, so restaurants that change orders frequently still use it. "It fades and it breaks more easily," says Iwasaki, "and it shouldn't be displayed in the sun."

Many restaurant owners order from catalogs. Iwasaki's 30-page tome includes a grilled chicken leg ($28), miso soup ($17), a glass of orange juice ($15), a strawberry parfait ($22), sweet-and-sour pork ($23) and a single slice of white toast ($8). Pages of "parts" feature such morsels as onion rings (raw and fried), fruit slices, eight sizes of shrimp, and ice cubes.

And for the really choosy, custom-made dishes

If the catalog doesn't have it, an owner can custom order, although the price goes up. A factory salesman sketches the dish from the real thing, sometimes borrowing the potatoes or an individualistic carrot slice. Even the fashion in fake food changes. "It happens every day," says Mr. Iwasaki. "Sometimes we have to change green peppers to red. Sometimes we have to change the direction of the whipped cream. Every chef has his own way to whip."

Whether the order is from the catalog or à la carte, the preparation process is the same. In most cases a mold is made from the real food—a *kanten* or Japanese gelatin mold if the item will be wax, a reusable silicone or metal mold if the item will be plastic.

On the top floor of Iwasaki's Tokyo factory, craftsmen are baking steaks. They pour mud-colored PVC into a silicone mold that has been made from a real sirloin; the white "fat" strip is already in place. This plastic steak is baked at 180 degrees C for ten to 15 minutes until it is hard. Then the steak is painted with dark brown stripes, to give it a grilled look.

The room with its windows at one end and its gray metal tables against the walls looks like a high school workshop. But it is a lot quieter—and there are small ovens on the tables. Artisans bend over their products, gluing rice, painting meatballs, arranging delicate platters of sliced raw fish. Their colleagues on the two floors below work with wax.

The techniques of producing fake food in Japan vary from company to company. Typically the "chefs" are reluctant to share their recipes—rice and noodles

Photographs by Mark S. Wexler

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Fake food is really cooking in Japan

Fake food is prepared at an Iwasaki factory. At right, worker heats plastic spaghetti with blow-dryer.

Plastic-food artisan at one of Tokyo's thriving manufactories applies paint to a cooked shrimp.

are both top secrets. But some of them have leaked out. The simplest foods to make are drinks. Colored glycerin and gelatin are poured into glasses; the drink is spongy but the ice cubes are hard. Tinted gold and poured into a tankard, it serves as beer. Tempura is trickier. Yellow-colored molten wax is poured into a pan of warm water so that it splashes and forms a rough batter. This is wrapped carefully around a plastic shrimp with a bit of tail sticking out.

Fake-food craftsmen learn on the job. Beginners start on "parts"—mushrooms, cucumber slices, peppers and other small items. After five years the artisan is making fresh vegetables and meats, and assembling whole dishes. But it takes at least ten years to learn to paint a whole, fresh fish, which is considered the most difficult food to reproduce. Only an expert can apply

The author, a former Associate Editor of SMITHSONIAN *magazine, now lives in Japan.*

Using chopsticks, he manipulates it into desired shape. Sketch beside him on table depicts custom-made dish.

Plastic helping of *soba*, a Japanese noodle, topped with seaweed and mushrooms, is removed from oven.

Cabin-attendant trainee for Japan Air Lines learns to serve meals in a plane mock-up—using plastic food.

the various shades of color on each scale so that the total fish achieves slimy perfection. Minoru Iwasaki (p.130), the 58-year-old head of the firm, specializes in painting fish. He has created a large collection of salmon, bonito, sea bream and dozens of other species.

Iwasaki traces the beginning of the family business back to 1952 when it was just a cottage industry. They made wax samples at home and sent them around to restaurants the next day. Today the firm has factories throughout Japan, and exports and produces abroad. Last year a New York art gallery featured some 30 specially made foods from Iwasaki, ranging from a $25 slice of unbuttered toast to a $1,300 salmon.

Beyond the gallery, fake foods are finding more practical uses abroad. They are used as teaching aids for caterers and airlines (right) and as props for advertising and trade fairs. Some have shown up as snow-pea earrings and strawberry pins. The way things look, expanding this market ought to be a piece of cake.

Still life with PVC lobsters (cooked at left; raw at right) is enhanced with silicone ice cubes.

Iwasaki's gallery-quality hamburger and fries sell for $350 (sesame seeds on roll are real).

Painting loaf and croissant is difficult: air brush is used first, then a paintbrush for finishing.

Skin and individual segments of mandarin oranges are made in separate molds; strawberry needs only one.

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By Ann Haskell

A poet of science who saw the world in a grain of sand

From one small, beloved corner of France naturalist Jean Henri Fabre pursued 'life's unfathomable secrets' everywhere

E. J. Detmold's classic illustration shows crickets, which Fabre regarded as Man's rival in house building.

I first encountered Jean Henri Fabre in a literature class. The fact pleases me, because his elegant writing belongs there as surely as in a course on botany, zoology or any other branch of what, in his day, was referred to as natural philosophy. Fabre's name is synonymous with entomology. Many of his books, like *The Life of the Fly*, *The Mason-Wasps* and *Social Life in the Insect World*, are world classics. But that identification is too narrow.

For Fabre was really a Renaissance man born to poverty in the 19th-century French provinces. Working alone, for the most part ignored by other scientists, he helped shift the scrutiny of science from the dead, pinned laboratory specimens that for so long preoccupied French academics, to the closely observed behavior of living creatures in the fields. Starting his professional life as a teacher of mathematics, physics and chemistry, he earned an advanced degree in natural sciences, and eventually wrote poetry, music and essays on matters natural, social, philosophic and psychological. His range of subjects included classical literature, astronomy, polar exploration and the need for children's books. His famous, ten-volume *Souvenirs entomologiques* still stirs devotion in readers, and he has been translated into 13 languages.

At l'Harmas the aging entomologist intently studies cocoons hatching in a gauze-covered bowl.

He was, in truth, a poet of science who saw nature's beauty and savagery with equal delight and awe, and could write about it unforgettably. Consider his description of the death of one hapless cicada: "It is late, and the Cicadae are silent. Glutted with light and heat, they have indulged in symphonies all the livelong day. In the dense branches of the plane-trees a sudden sound rings out like a cry of anguish, strident and short. It is the desperate wail of the Cicada, surprised in his quietude by the Green Grasshopper, the ardent nocturnal huntress, who springs upon him, grips him in the side, opens and ransacks his abdomen. An orgy of music followed by butchery."

All his life Fabre evaded formal society, its structures and strictures alike. He would have enjoyed the fact that he now defies its labels as well. The only title he ever admitted to was Inspector of Spiders' Webs. Fabre might have become anything: the official topics of his essays were merely compass points through which he drew the dazzling arcs of his ideas. His writing begins with whatever excited him, and for Fabre, nature was always accessible and always absorbing.

His scientific language and his field observer's point of view are so familiar to modern science that today it is hard to appreciate the world from which he emerged. He was born in 1823, when Thomas Jefferson was still alive, and he died in 1915 after the start of World War I. His lifetime saw the arrival of barbed wire and the automobile, the airplane, the telephone and pasteurized milk. When he died, phosgene gas and

Color photographs by Denis Waugh

Sigmund Freud's subconscious were the latest things.

Jean Henri Casimir Fabre's family was as intractable and dour as the cold, gray granite of the Aveyron country where the Fabres lived at the time of his birth. They were poor and largely illiterate. But early on he was given the job of duck tending, a chore that left him time to rove the fields, lying on his back to watch the clouds or, rolling over on his stomach, to study the work of ants and the architecture of anthills. He was interested in birds, too, though he sometimes, as boys will, collected eggs. His mother chastised him harshly for returning home evenings with his pockets full of useless junk, but her sharp tongue could not keep him from gathering eggshells, snails and stones streaked with mica. A lifelong pattern was begun.

Courtyard of l'Harmas, the house near Avignon that Fabre loved, and worked in, for more than 35 years.

Perhaps because he was so curious, school was magic to him. It supplied form for the shapes and sounds and textures the boy had already found by himself in the fields. To the exciting jumble of magpies' wings and cicadas' songs was added the ordered beauty of Virgil and geometry.

Life became a balancing act composed of education and the menial chores for which Fabre earned a wage that for years kept him just above the poverty level. He worked for his father and grandfather, and on road-building crews. He sold lemons at the Beaucaire fair. He did odd jobs for pay at every school he ever attended. And eventually he worked at teaching—first in a grammar school in Carpentras, later the high school in Avignon, but never at the university, though he had longed for years to reach that level.

Fabre's pay from teaching was tiny. If he bought a book, it cost a month's wages and meant going without food. Even after he received his doctorate (he wrote his theses on orchids and centipedes), he always had to work at the additional jobs of tutor, drawing instructor and part-time museum curator in order to support his wife, Marie, whom he married in 1844, and the five children they eventually had.

No increase in either rank or pay

Though he taught as conscientiously as he did everything else, Fabre did not advance in his profession. The very qualities that made him a successful teacher —innovation, intellectual agility—provoked the scorn of his colleagues. He barely disguised his disapproval of the rigid system in which he worked; in its turn it failed to reward him. During the last two decades of his teaching, from 1852 to 1871, he never advanced in rank or salary.

Living without praise and withstanding harsh criticism, he nonetheless continued his experiments and his field trips. One of the few people in education who understood Fabre's great gifts was Victor Duruy, who became Minister of Public Instruction under the Emperor Napoleon III. It was Duruy who first urged Fabre to write popular-science books for children. Duruy also awarded Fabre the Legion of Honor, in part for his work in isolating from madder root the valuable dye element alizarin, though Fabre, a poor businessman, never realized the financial gain that he might have expected. It was Duruy, too, who interested the Emperor in offering Fabre a post as tutor to his children. Fabre showed such distaste at the thought of city life in Paris that the arrangement was never pursued.

Work desk at l'Harmas is backed by cases full of coins, shells, nests—but few pinned-and-mounted insects.

Most important, it was Duruy who, in the spring of 1870, invited Fabre to give a series of public lectures in Avignon, to an audience which included a large number of secondary school girls.

That turned out to be a pivotal event of Fabre's life. He was already 47 years old. He had published a handful of brilliant academic articles in learned journals that were well received, at least by a small number of people. But the dozen or so Avignon lectures for the first time brought the obscure Fabre face to face with an audience of nonspecialists with whom he could finally share his scientific poetry.

What must he have thought about, walking to the lecture hall on those mild spring evenings in Avignon? How must it have felt to reveal the excitement of 30 years' work? We know little about the subject of the lectures, beyond the fact that they delighted some people and shocked others. What, one wonders, from among the hundreds of subjects that engaged him, must he have chosen to talk about? Perhaps the killing of the cicada by the grasshopper. Or what he once called "the imperiousness of a thunderstorm." Or perhaps the ingenuity of the dung beetle.

There have been romantic film biographies of Fabre, a Russian version before World War II and *Monsieur Fabre*, produced in France in 1951. But it is difficult to improve on the real drama of his life, for even this moment of triumph was shadowed. Though the lectures were a popular success, they exposed his ideas about the life of plants and animals to a less sympathetic audience. His jealous teaching colleagues objected to Fabre's discussions of such subjects as the mating habits of insects and to his open advocacy of teaching science to girls. A public scandal was soon whipped up. In Avignon Fabre was labeled "an unsuitable person." In quick succession he was denied continued residence in a house he had long rented in the city and all but forced to resign his teaching job.

Nearing 50, jobless and homeless, Fabre was required to earn his living by the only means left: writing the books that are still read today.

Fortunately his lecture audiences included some famous people. Eventually the list of his correspondents became very impressive. A long-lasting friendship that continued by mail for many years started with Frédéric Mistral, a fellow Provençal and a future Nobel Laureate in literature (1904). Fabre began a correspondence with Charles Darwin, who in 1859 had cited some of Fabre's early work on the *Sphex* wasp in the first edition of *On the Origin of the Species*. The Fabre-Darwin letters constituted respectful disagreement—Fabre did not approve of Darwin's theory because evolution seemed to reduce the influence of instinct in animals and insects, which Darwin regarded as flexible but Fabre saw as rigid and all-powerful. The great evolutionist at one point described his French correspondent as an "inimitable observer," a label accurate enough for an epitaph if Fabre needed one.

Among those present at his lectures was his friend John Stuart Mill, a longtime resident of Avignon and an enthusiastic fellow naturalist, who accompanied Fabre on nature walks until the English philosopher's death in 1873. The last letter Mill ever wrote was a letter to Fabre. And it was the author of *On Liberty*

Michel Plisson

To study insects' eating habits, Fabre put animal bait in a pot, kept "out of reach of cats" on bamboo tripod.

Part of Fabre's natural domain was this luxuriant garden. But the landscape of his mind was broader.

who freed Fabre from the chains of his worst financial disaster.

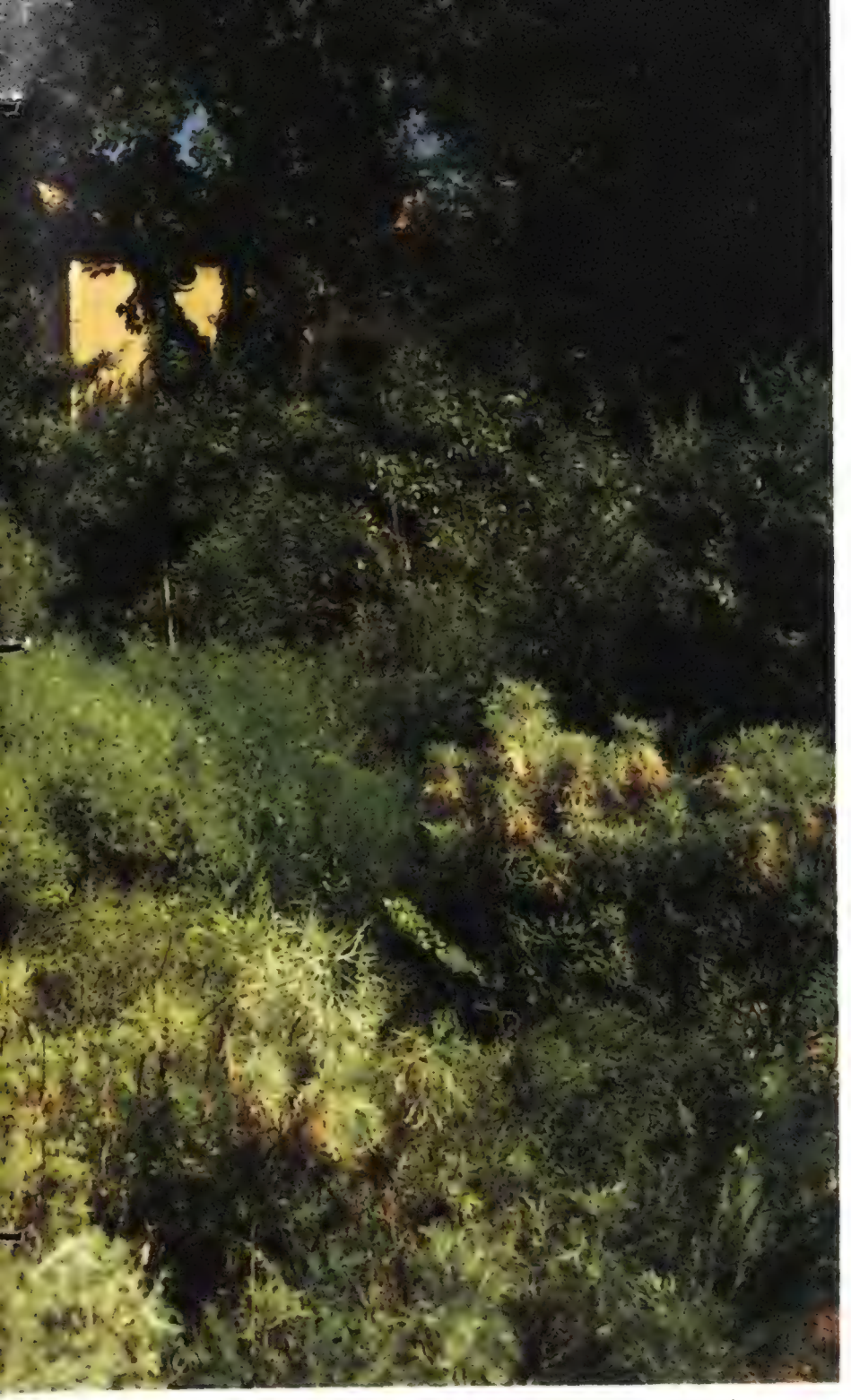
At the time Fabre resigned from the school, Mill gave him an unconditional loan of 120 English pounds. The money enabled Fabre to write full-time and eventually, in 1879, to fulfill a lifelong dream of owning a house with a small plot in Sérignan, 15 miles from Avignon. Fabre promptly named the place l'Harmas (for rocky, worn-out land), and this homestead of a single hectare (2.5 acres) became the famous "laboratory of the open fields," the world in a grain of sand that thousands of children have read about in textbooks. It was an "Eden of bliss where I mean to live henceforth alone with the insects" (right).

Throughout, Fabre's writing displays only slight traces of the mannered, formal 19th-century style fashionable in his time. Though his subjects are closely, even clinically, observed, his writing is still fresh, subjective, dramatic, full of suspense. Consider this, about the mating of scorpions, written in 1904:

> Two scorpions, one of either sex, face each other with claws outstretched and fingers clasped. Their tails prettily curled, the couple stroll with measured steps. The male is ahead and walks backwards; the female follows obediently, clasped by her finger tips and face to face with her leader. At times the male turns gracefully to right or left and places himself side by side with his companion. Then, for a moment, with his tail laid flat, he strokes her spine. She stands motionless, impassive. For over an hour I watch, and then something happens. The male has found a shelter to his liking. He releases his companion with one hand, and, continuing to hold her with the other, he scratches out with legs and tail a shallow opening in the sand underneath one of my crocks. He enters and slowly, without violence, drags his patient partner after him. A plug of sand closes the dwelling. The couple are at home.

Fabre's essays are characterized not only by a fine control of setting, pace and structure, but show his gift for compelling imagery as well. Deftly he juxtaposes the crab spider, whom he describes as "a murderess," a "cutter of Bees' throats," with her favorite bower, "the white-leaved rock-rose with the large, pink, crumpled, ephemeral blooms that last but a morning and are replaced next day. . . ." However, he comments, she is "a pretty creature despite her unwieldy paunch fashioned like a squat pyramid and embossed on the base, on either side, with a pimple shaped like a camel's hump." Not all crab spider females are so unattrac-

The author last wrote for SMITHSONIAN, *December 1981, about medieval women's life-style. A lover of France, she has a house not too far from Avignon.*



It extended beyond plants (and insects) to glaciers, children's books, "imperiousness of thunderstorms."

tive. "There are," he notes, "fine ladies among them who adorn their legs with a number of pink bracelets and their back with carmine arabesques."

The heart of Fabre's writing is *Souvenirs entomologiques*, a collection that displays his lifelong passion for matters involving heredity and instinct, includes some poems, the bulk of his essays on insects and plant life, observations on ethics, anthropological theories, even a short autobiography.

The map of Fabre's personal world is remarkably small. It is contained within a tiny patch of the western Vaucluse country. With the exception of his birthplace, a hamlet in the Aveyron called Saint-Léons, and a brief, early teaching stint in Corsica, his entire life was spent within a 20-mile radius around the cities of Carpentras, Avignon and Orange. It includes, besides the town of Sérignan, Mont Ventoux (known as the Giant of Provence), the westernmost of the French Pre-Alps that Fabre climbed so many times.

I went to live in the Vaucluse in 1974. I remembered that Fabre, too, had lived "in the South of France," but was amazed to find that his home was only a short distance away. Since then I have made many trips to l'Harmas, trying to discover not only the physical world of Fabre, but the landscape of his mind as well.

I first visited l'Harmas at the height of summer, when the senses grow drunk with smells and colors of flowers, and Fabre's gardens were alive with the zoom and buzz of insects. This is the season when it seemed likeliest that Fabre himself might be found.

But what did he look like? The bronze sculpture in the middle of town, a coy, larger-than-life *Saturday Evening Post* cover, is surely not Fabre. The plaster bust in the hall outside his l'Harmas atelier yields nothing. The stiff face on the postcards is tinted and lifeless. What was he like, an adoring fan wonders. Remote? Pleasant? Severe?

Like a small boy's pockets turned inside out

I look at the glass cases, bulging with birds' nests, old coins, shards of ancient pottery. Like a small boy's pockets turned inside out, they are evidence of a lifetime's passion for collecting, but little more (p.143).

I examine his correspondence under glass. There is an 1880 letter from Darwin, suggesting that Fabre try an experiment for testing the sense of direction in cats by disorienting them in a twisting bag. He writes "I was led, as I believe, to think of the experiment from having read in Wrangel's *Travels in Siberia* of the wonderful power which the Samoyedes possess of keeping their direction in a fog whilst travelling in a tortuous line through broken ice. With respect to the cats, I have seen an account that in Belgium there is a society which gives prizes to the cat which can soonest find its way home, and for this purpose they are carried to distant parts of the city. Here would be a capital opportunity for trying rotation."

I read the text of a poignant letter that Fabre wrote to his daughter Claire on the stillbirth of her child. I examine some delicate drawings of mushrooms, barely saved from a distress sale only seven years before Fabre's death, when the old man once again needed money. I look at his walking stick, the old black hat he was never without and the leather bag for carrying specimens. I look at the simple box of paints, the very brushes and colors he used. But the personality of the reclusive man himself is absent. Even his ghost, it appears, cannot abide company.

Then one day in winter, under a thin January sun, with almost no flowers in bloom, few leaves even in evidence, not a tourist in sight, alone in a remote part of the garden—I finally found him. Standing in a little

grove, now bare and quiet, at the least likely month of the year, I knew what he was like.

In a season that symbolizes death, Fabre's garden was filled with life. This was, I realized, the time when one can best see to the heart of things, observe patterns, really look at shapes obscured by summer foliage. Without leaves, the schema of the garden itself is evident; an overall plan for paths, pond and planting yards emerges. For the first time I understood why in France the plant I know as Japanese lantern is called *Amour en cage*: its familiar orange, now see-through brown lace, reveals a large seed at its center.

Winter is a time for conifers. A magnificent Atlas cedar, centerpiece of the southern part of Fabre's garden, which I have mostly shunned in favor of midsummer razzle-dazzle, suddenly stands out. I admire an immense Corsican pine, placed at the intersection of several paths to lead the walker around it. There are mulberries and dense groves of boxwood.

The most arresting sight is a dramatically stark, dried plant that might have been constructed by Giacometti. The name on its label is *Epine du Christ* (Thorn of Christ). I have passed it before, but for the first time I see it, gaunt and sombre as the sculpture of shards in bombed-out Coventry Cathedral.

Gold carp, lacing back and forth through the clouds reflected on the surface of a tiny pond, recall Fabre's fascination with water. "A stagnant pool, though but a few feet wide," he wrote, "is an immense world, an inexhaustible mine of observation." Dew glitters on everything, catching the meager sun. Ferns, thick and confident in the mildness of this climate's easy winter, feather up to the elusive light.

The garden also includes Fabre's homemade insect-attracting devices, evidence of a lifetime of ingenuity. There is a pot in which an earth-filled hollow post, topped with a viewing dome, has been placed for observing the burrowing of beetles. Fabre's respect for life, for the ecological chain, is evident in a special Rube Goldbergian contraption which carries the following words: "Device invented by J. H. Fabre to catch carrion beetles for his experiments. The bait: a rat, mole or other small dead animal was placed in the receptacle out of the reach of cats" (p. 143).

The Carpentras school at which Fabre began teaching in 1842 he once described as a penitentiary, where "the freshness of Virgil was interpreted in the stifling atmosphere of a prison." It is not far to the tiny, rented room, where, he wrote, "I pored over differentials and integrals" and "calmed my poor burning head by gaz-

Vaucluse countryside stretches over hills toward Fabre's favorite mountain, Mont Ventoux (center).

ing at Mont Ventoux." The mountain was climbed by Petrarch in 1336, who is thus said to have officially started the Renaissance by being the first man ever to climb a mountain just for the view. Fabre climbed it repeatedly to see everything, view included (below).

His favorite local expeditions, though, were along the old Chemin Creux, a sunken road southeast of Carpentras. As the ancient path wore deeper and deeper, layers of earth, a complicated tangle of roots, and thousands of insect inhabitants were exposed. Today the Chemin Creux is a shadowy, sometimes frightening road in whose narrow, twisting path automobiles sometimes come face to face with no advance warning. Fabre once wrote of it, "You are my promised land, where I would have sought at the last to pitch my observer's tent."

In Avignon, a city filled with history and the memory of schismatic popes, I stand in the doorway of a shop on, yes, the Avenue Fabre and look across to the former Abbey of Saint-Martial. Here Fabre delivered the public lectures. Inside, in the half-light, I seem to see faces from a hundred years ago, some shocked, some intense with interest as their Lewis Thomas first stirred them with the magic of science—"the splendours which accompany the birth of a drop of water."

Anyone who wants to follow long in Fabre's footsteps must climb Mont Ventoux. With an automobile the 6,273-foot ascent is easy. It takes less than half an hour. But for Fabre the trip in a wagon represented a full-scale expedition. Of his 23rd ascent, made in the summer of 1865 with seven other people, he wrote: "Half a day's journey in an upward direction brings before our eyes such a succession of types of vegetation as we could find in the course of a long journey north through Europe to the Arctic Circle."

The mysterious influence of this peak, present in the awareness of everyone in this part of France, also had its effect on Fabre, who especially loved to see sunrises and feel the flash of thunderstorms here. At the top, in the perpetual wind that gives Ventoux its name, one sees the Swiss Alps, the Massif Central, the Vaucluse and the whole of Fabre's world—l'Harmas is a flyspeck, its gnats, crickets and scorpions invisible. This is a place that gives perspective, that demands reflection. The wind blows away silliness. The height exhilarates. It is a perfectly appropriate setting for a man to write, "Life has unfathomable secrets. Human knowledge will be erased from the archives of the world before we possess the last word that the Gnat has to say to us."

He climbed its 6,000 feet more than 40 times in search of perspective, inspiration—and a glorious view.

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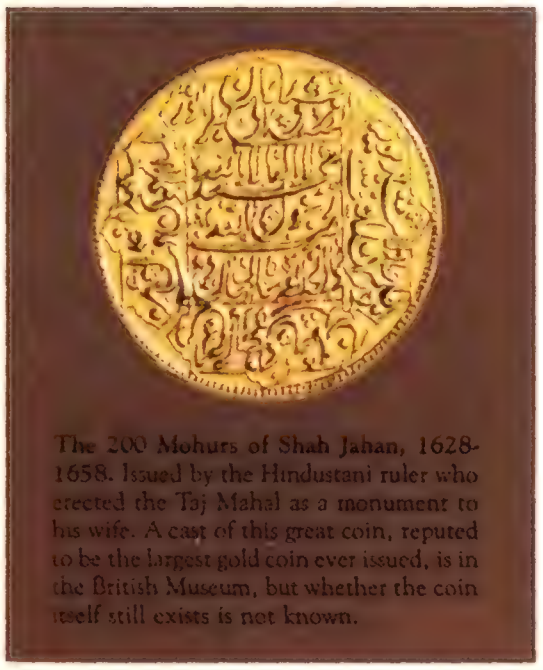

The 200 Mohurs of Shah Jahan, 1628-1658. Issued by the Hindustani ruler who erected the Taj Mahal as a monument to his wife. A cast of this great coin, reputed to be the largest gold coin ever issued, is in the British Museum, but whether the coin itself still exists is not known.

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Fateful cloud, rising 5,500 feet over Bikini Atoll, July 25, 1946, was recorded from photo plane flying eight miles away. The apparently dwarfed vessels are old warships anchored to measure shock, radiation.

By Dino Brugioni

Aerial photography: reading the past, revealing the future

With new tools and techniques, a young science is flying high, and proving useful in unexpected and peaceful ways

Every morning an unmarked government vehicle rumbles out through the gates of the Central Intelligence Agency complex in McLean, Virginia, and heads through the gray dawn to Washington. A half-hour later it has arrived at the west entrance of the White House, bearing a guard, an intelligence officer and briefcases full of materials for the daily briefing session of the President of the United States. More often than not, along with dispatches from trouble spots around the world, the material includes sheaves of photographs taken by high-altitude overhead reconnaissance systems.

Surveillance and Soviet shoe pounding

Extremely sophisticated cameras and techniques serve us as eyes in the sky these days. Lenses peer down from a variety of orbiting satellites, whizzing around the Earth at 18,000 mph, anywhere from 100 miles to 22,300 miles high. Ultra-high-flying planes have long operated at more than 80,000 feet.

Many photographs, for military and strategic purposes, have been acquired under the international provisions of the SAL (Strategic Arms Limitation) treaty, which essentially stipulates that our side is free to photograph your side and your side is at liberty to take pictures of our side, just as long as neither side interferes with each other's "national technical means of verification." But the whole eerie practice of military surveillance from the sky, and Soviet sensitivities about their borders (as last fall's savage shooting down of Korean Air Lines Flight 007 by the Soviets demonstrated to all the world), is fraught with danger.

The Korean tragedy is only the latest in a long series of events that have helped fix overhead surveillance in the mind of the American public as crucial to military security, but also as a possible cause or cure of many an international confrontation. In 1960, it was the shooting down over the USSR of an American pilot and his ultra-high-level aircraft that produced the abrupt close of a top-level East-West peace meeting. The event also provoked some of Soviet Premier Nikita Khrushchev's most bellicose antics, including shoe pounding at the United Nations. In 1962, aerial photographs offered the first sure proofs of Soviet offensive missile installations in Cuba, leading to President Kennedy's "quarantine" and subsequent deadly showdown with the Soviet Premier. Months before the recent U.S. landing in Grenada, President Reagan presented the TV public with eye-in-the-sky images from his own daily CIA briefing that showed one cause of U.S. and Caribbean uneasiness: the 10,000-foot runway being built on the tiny island by armed Cuban work gangs.

The accumulation of aerial photographs has grown geometrically since World War II. In the United States

In this startling 1964 image, an angry Congolese threatens treetop-skimming photo plane with a spear.

alone more than 350 private, local, academic, state and federal agencies maintain some sort of aerial photography archives. The Departments of Agriculture and Interior hold more than 15,000,000 individual frames of domestic photographs, which if laid end to end would stretch from New York to Salt Lake City. (Another large archive, the EROS Data Center at Sioux Falls, South Dakota, part of the U.S. Geological Survey, stores more than a million photographic exposures taken from assorted space vehicles.) And the uses of aerial surveillance are multiplying dramatically.

Yet the whole evolving process goes back only to 1858, when a Frenchman named Félix Tournachon (popularly known as Nadar) slowly rose above Paris in a gas balloon carrying what was then a new and unreliable invention, the camera. Two years later, a couple of Americans ascended 1,200 feet over Boston and exposed six glass photographic plates.

From the beginning, the military possibilities were breathtaking. During the Civil War, on September 24, 1861, Thaddeus S. C. Lowe ascended in a balloon near Arlington, Virginia, and for the first time accurately directed artillery fire onto unsuspecting Confederates at Falls Church. Aerial surveillance was on its way. But it was not until World War I that specially trained

U.S. fighter plane got this intimate portrait of German defenses just before the D-day landings in Normandy.

Battle film of Tarawa shows wire Japanese put offshore to channel landing craft into prearranged fire lanes.

flying photographers began to work systematically. The *Scientific Monthly* for April 1918 describes cases in which "only 20 minutes" elapsed from the time a photographer took a picture over the German trenches until American artillery officers were using the results to bombard enemy lines.

Naturally, World War II pushed such techniques beyond all previously imagined frontiers. Swift fighters were stripped of guns so cameras could be put aboard. Movie units routinely flew along with bombing missions.

In 1944, based in North Africa, Italy and Corsica, I flew on 66 missions as a photographer in B-25 light bombers. Early each morning we would be airborne, trying to establish (in those days of swift and fluid campaigning) the exact whereabouts of our constantly advancing lines. This was a tricky and uncertain business, made only somewhat easier by those few generals, like George S. Patton jr., who, as their divisions advanced, had distinctively colored, T-shaped panels laid out on the ground with the top of the T parallel to the American front line of the moment.

We got plenty of pictures. Interpreting them properly was something else again. Camouflage often fooled pilots and photo interpreters on both sides. (In England, dummy airfields built near the camouflaged real ones looked so authentic, not only in photographs but to the naked eye, that several U.S. and British pilots attempted to land.) But photo interpreters learned to pierce skillful camouflage by reading such things as shadows. If the shadows of similar objects were all the same length, they were probably real.

Roads also could be a telltale sign. Did they actually *lead* somewhere, or did they stop suddenly, perhaps because they were disappearing under camouflage netting (p.155)? Interpretive skills once kept the Royal Air Force from being fooled by a German fake airfield in North Africa, even though it was expertly set about with dummy aircraft. In one of an ugly war's few aerial jokes, the RAF dispatched a lone bomber to drop wooden bombs on the dummy German planes!

When Japan invaded the Aleutians, U.S. forces set up a tight sea and air blockade aimed at barring all supplies of fuel from reaching the Japanese base at Kiska. Yet a Japanese squadron kept right on flying. It was clear they were getting fuel from some forward

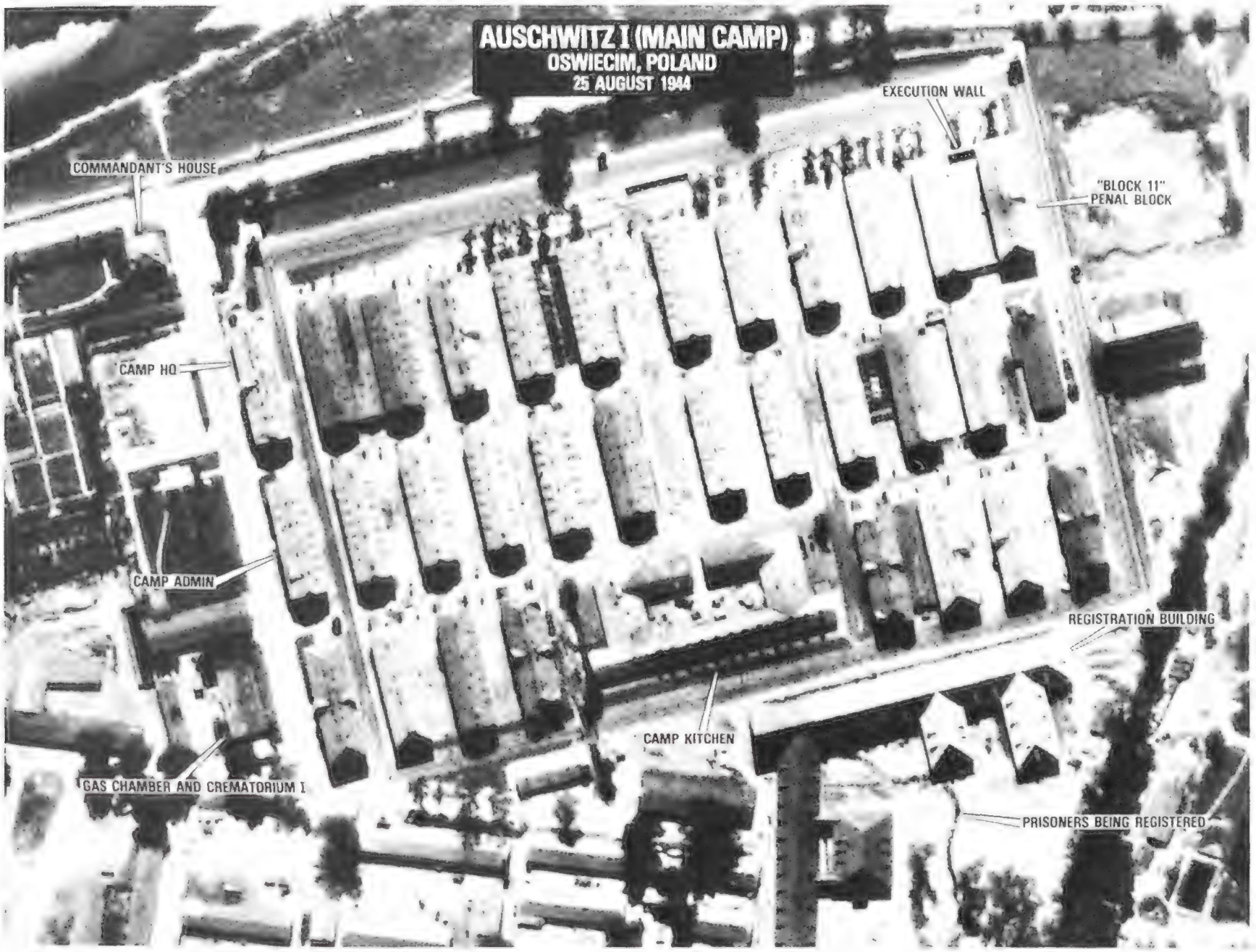
The author, a retired expert in reconnaissance and photo interpretation for the CIA, frequently writes about aerial photography and history.

area depot. But where? For a time, low-level reconnaissance missions failed to solve the mystery. Aerial photos did show some dummy Japanese planes just off the end of the only runway, but these were such palpable fakes that whenever they attacked the airfield, American pilots did not bother bombing the parked planes. Then one day a U.S. bombing run ran long by mistake, so that a string of bombs, apparently wasted, began hitting beyond the runway, and in fact walked right through those dummy aircraft. Suddenly the ground erupted in huge pillars of flame and smoke as the long-hidden fuel dump blew sky-high. The Japanese had hidden it under the obviously fake Zeroes.

Ultrasophisticated, or special, readings of aerial photographs sometimes produced embarrassing results. In 1944 I flew on a mission near Udine, Italy, trying to pinpoint the exact position of a German infantry division we knew was on the move. We also knew that, unlike American GIs, German foot soldiers wore white underwear. When a German unit moved, it would usually do so at night, resting concealed next day. And often the Germans, after a hard night's march, would wash their shorts and skivvy shirts in the morning, and hang them on bushes to dry.

So when we noticed a lot of white specks beside a stream, I yelled out, "Maybe we've found those Krauts!" When the film was rush-developed, the prints showed my discovery was a flock of sheep.

Oblique-angle exposures taken from a speeding plane at low altitudes often revealed more than high-altitude pictures photographed straight down. The technique used was known as "dicing," partly because the photographs produced were only slices of a whole picture of a terrain that had to be fitted together later. The other reason: pilots sometimes threw dice about such missions. Losers got to "dice" for real, flying un-



In 1978, experts, hunting through overrun film taken from 30,000 feet during 1944 bombing raid on nearby Nazi factory, found this picture of Auschwitz. It shows (lower left) gas chamber where *Zyklon-B* gas was first tested; lines of stronger prisoners (lower right) on way to slave labor; Block 11, camp's torture chamber.

How camouflage works is illustrated by World War II pictures of the Lockheed plant in Burbank, California, at the left without camouflage, and, opposite, after experts have tried to hide it from aerial surveillance.

armed over the enemy—and practically on the deck.

Dicing, which provided some of the most startling images (p.152) and hairbreadth escapes in World War II aerial photography, was also used later, sometimes during comparative states of peace, where low-level reconnaissance seemed the only way to get certain kinds of intimate intelligence.

One of the most startling confrontations (and pictures) thus produced occurred in 1964, when the United States and Belgium were planning rescue operations of more than 3,000 missionaries and hostages in the troubled ex-Belgian Congo. U.S. Air Force dicing runs were flown around mission compounds, both to discourage possible attackers and to provide a better idea of what local guerrilla forces were up to. On one sweep an Air Force camera caught an amazing 20th-century image. It showed an African villager about to hurl a spear at the low-flying photo plane.

Marshall Carter, then Deputy Director of the CIA, injected a print of this into his briefing presentation for ex-President Harry Truman. "Mr. President," Carter dryly noted, "this is a surface-to-air missile, Mark 1, Model 1." After studying the picture Truman gravely urged that pilots fly a little higher in the future. "Imagine what it would be like," he said, "for a young Air Force officer to live through his career with the notation in his service record that he was downed with a spear."

Planning for the Normandy landings, June 6, 1944, was based largely on information derived from aerial reconnaissance. In the largest interpretive effort ever undertaken, experts pored over thousands of photo-

Artifice included telephone poles that supported cable spread with huge sheets of painted scrim topped by dummy bushes, trees, even houses. Giveaway is road to nowhere beside the building at center left.

graphs, pinpointing enemy beach defenses, troop dispositions, radar screens, supply dumps, airfields and lines of communication. It was the interpreters who selected the beaches and airborne landing areas to be assaulted by Allied forces. More than 1,700 officers and enlisted personnel worked around the clock studying a daily take of 85,000 negatives and prints.

Photographs acquired during World War II still have a great—if rarely exploited—value, especially to historians trying to reconstruct the past. In 1978, 33 years after the war, my curiosity about the Nazi death camps was rekindled, and with Bob Poirier, a research colleague, I began to look back into the records. We knew that in 1944 bombing and aerial photographic missions had been conducted on the I. G. Farben synthetic fuel and rubber plant, only five miles from Auschwitz-Birkenau. The route of reconnaissance or bombardment planes bound for the plant lay directly over Auschwitz. Since cameras were turned on a few minutes before the target and left running a few minutes after the strike, we soon discovered detailed aerial photographs of the death camps in operation—something that had been entirely overlooked during and after the war. Analyzing them we could see the four large complexes of gas chambers and crematoriums whose round-the-clock operations were killing 12,000 to 15,000 people per day. Bodies were being buried in trenches or burned in large open pits. In one photograph we could spot victims being marched to their deaths and in another a line of prisoners being processed for slave labor (p.153). The aerial photos uncovered have since been described by Israeli experts

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as among "the largest caches of information ever found on Auschwitz." They are now on display at the Yad Vashem Holocaust Museum in Jerusalem and at the Auschwitz-Birkenau Museum in Poland.

The Marine Corps Historical Center in Washington, D.C., recently found a packet of low-altitude photos taken on November 20, 1943, during crucial hours of the assault on the Pacific Island of Tarawa. These provide a front and rear view of the Japanese defenses, as well as a direct rear view of the Marine attack. At the actual moment when the pictures were being taken, correspondent Robert Sherrod, who wrote the classic eyewitness account of the battle, was pinned down behind a seawall. But when I showed him the pictures, he said, "None of us on the ground that day got any such view—if you even raised your head, you were immediately shot at by the Japanese."

Picking up prehistoric sites from the sky

World War I German aerial photo surveys made of the Sinai peninsula later revealed traces of ancient settlements, until then unknown to modern archaeologists and historians. From the 1930s onward, photographs taken over England and the European continent showed prehistoric archaeological sites that people on the ground had long trampled over unwittingly. Though buried underground, ancient walls and buildings affect the plant growth above them: it is never quite as lush as the rest of the surrounding fields because the roots can't go as deep, and the resulting pattern is visible from the sky.

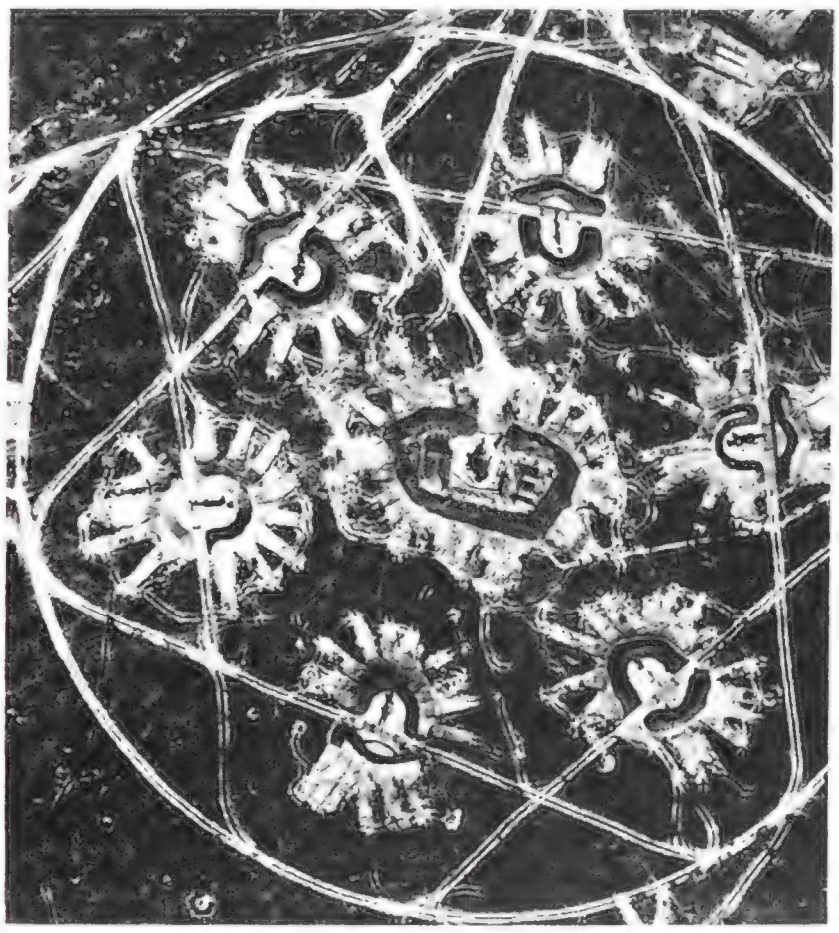
Maya canals dug 1,500 years ago—apparently to feed a population of more than two million, and now hidden in the thick jungles of Guatemala and Belize—might never have been found by archaeologists slogging through growth with help from machete-wielding crews. But they are visible in aerial radar images.

All over America, too, aerial film, properly examined, offers telltale signs of past history. In regions of Oklahoma, tracks from pioneer wagons can still be seen. Settlements along the Alaskan coast, some going back many centuries, can be located in pictures that reveal the periodic areas of lush growth of plants where the bones and remains of animals were tossed before the inhabitants moved on.

In the past 25 years the precision and interpretive possibilities of aerial surveillance have expanded dramatically, mostly due to technical advances. The two best-known examples were in aircraft design: the creation of the U-2, known as the Angel, and the SR-71, five times faster than the U-2 and known as the Blackbird because it was painted dull black to keep it from being noticed.

The Angel came first. It is a beautiful, long-winged,

Bomb hit on Korean bridge is frozen in time by "strike photograph" from automatic camera in plane's belly.



This Soviet missile pattern, a so-called Star of David, told U.S. experts Russians were arming Cuba in 1962.

Mysterious triangle, a half-mile long, scraped on a Peruvian plateau a millennium or more ago, is one of many ancient ground drawings and earthworks whose extent or location is fully visible only from air.

gliderlike craft with an immense range, and it can fly at 70,000 feet—an unheard-of altitude in 1955 when the plane was first being developed by Lockheed designer Clarence (Kelly) Johnson. Equipped with new, light, Mylar-based film and fitted out with a new B-camera and a computer-ground lens (designed by photographic geniuses Edwin Land and James Baker), the craft could "see" and record parking-lot stripes and parking-lot numbers from eight miles in the air. Despite the fact that one was shot down over the Soviet Union, the Angel was and still is a marvel. During U-2 overflights of Soviet Russia, the bomber gap, the missile gap and the megatonnage gap were dispelled as myths. Its eyes provided much of the detail and data during the Cuban missile crisis. Aerial surveillance is still a considerable boon to potential disarmament agreements, because it makes possible scheduled "on site" inspections without the need for foreign inspection teams actually to be located on the ground in either of the countries.

A new role for that kind of reconnaissance was its contribution to the peace-keeping process in the Middle East. An integral part of the Truce Agreement ending the Yom Kippur War of 1973 involved periodic reconnaissance by U.S. aircraft to verify Egyptian and Israeli compliance with the military limitations specified in the Treaty of Peace between the two nations.

Of course the most spectacular and complex new tools in the long quest to learn about our own planet (and other planets) by observing them from on high are based on orbiting satellites and probes. These have now turned the aerial cameras on our solar system. Instead of viewing from afar with limited detail, we are able to get "close-up" images flashed back from space-traveling vehicles like Voyagers I and II.

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Taken from miles above, two days before Grenada invasion, this photograph documented arrival of plane carrying a colonel in charge of the Cuban forces.

imagery-derived data has progressed in quantum leaps in recent years. Even greater opportunities are in the near future because such pictures can be digitized, and the combination of photo interpretation with computer technology will provide all sorts of new uses for the material, in addition to daily weather maps.

The advantage of image-making from space is that vast areas can now be recorded in a single photographic frame in a relatively short period. Routine Landsat (for Land satellite, an Earth-observing satellite) photographs in the late winter of 1983, showing the mountain ranges in the West, revealed that the snowpack was much greater than ever before. This meant that heavy floods would result. I recently testified before a Congressional subcommittee that if the federal government had used available reconnaissance data and expertise, last spring's devastation and loss of life from floods in the West could have been largely prevented.

I believe that a task force of Washington-area reconnaissance, mapping, photogrammetric and photo-interpretation analysts, working with Western regional experts, could have produced a suitable plan for antiflood action. From overhead photography, photogrammetrists could compute the volume of snow in the mountains, and hydrologists could then reckon the volume of runoff water. From the lay of the snow in the mountain valleys it would be possible to tell which streams and rivers would carry the most water, so that the water level in strategic dams and reservoirs could be drawn down in advance. In the future, such collaborative efforts could go far to prevent flood damage and desperate, last-minute evacuation.

Taking a head count from on high

Another potential new area for aerial search is the U.S. Census. In 1980 the census cost more than a billion dollars. There are ways in which a federal census —at least, the actual population count called for by the U.S. Constitution—could be done more accurately and for a fraction of its 1980 cost. Through space-age photogrammetric techniques, it is now possible to count homes and measure buildings in sample segments and then—with techniques similar to those used for predictions as votes are still being cast on Election Day—come up with an accurate census from the air.

The steadily increasing collection of aerial photographic archives, morever, may prove useful in ways we can hardly imagine today. During the 1930s, for example, farmers were paid by the federal government to plow under a portion of their crops. To prove there was compliance with the agreement, photographic missions were flown over the farm areas. After its immediate practical purpose, most of this film for-

tunately found its way into the National Archives.

Forty years on, when staffers at the Environmental Protection Agency began seriously seeking out old toxic-chemical dumps, they found that such pictures inadvertently provided them with the most reliable record of the existence and location of waste sites used decades before, then abandoned and forgotten, but in many cases still hazardous.

History is a chronology. It is most usually read as a record of change. One of the most faithful recorders of change is the photograph. Each day thousands of aerial photographs are taken for all sorts of purposes by private organizations and by local, state and federal agencies from a wide variety of heights. Each photograph helps establish a base-line reference point that has critical importance in recognizing (and measuring) any changes the future may bring.

Few people, or even government agencies, are aware of this material. Fewer still know how to interpret it. Astonishingly, too, there is at present no standard method for correlating and retrieving the information that aerial photos provide, although the standardized procedures worked out in 1974 by the National Cartographic Information Center in Reston, Virginia, were a large step forward. The Library of Congress, like hundreds of great libraries around the country, has a standard index and retrieval system. But there is no subject-category system for finding desired film. No index-card or computerized references for recording the results of each mission exist.

There is not even a rough national master plan for preserving the older (pre-World War II), nitrate-based film that is now deteriorating rapidly. Aerial photography as a medium for historical research has been almost totally overlooked by the academic community. I know of no university history department in the United States that teaches a course in photo interpretation as part of the historical process. Yet it is historians and great universities that are the natural students, interpreters and custodians of this body of information. And they clearly should take the lead if an irreplaceable legacy is to be preserved.

Alaskan volcano, Mt. Veniaminof, was regarded as dormant until this photograph from Spacelab 1, 155 miles up, revealed a dark fumarole in volcano's snowy crater. Photos of mountains in winter can be used to compute depth of snow and relative amount of spring runoff, so lowlands can prepare for flooding.

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Article and photographs by Fiona Sunquist

Cut and burn in a Nepal park: all in the plan

Third World countries are inviting people to use the resources of wildlife refuges; in Royal Chitawan, the scheme is working

The early morning air is cool and damp, filled with the noise of birds, and the two-rut road is covered with signs of the previous night's traffic: from our perch on the broad back of an elephant, we can see soup-plate-size tracks of rhinos overlaid with the delicate pointed prints of spotted deer, large lacy tracks of peacocks and the small, neat feet of jackals. A tigress has walked along the road during the night, detouring several times to urine-spray trees and bushes. We record the locations and heights of the spray marks: my husband, Mel, is studying their social organization and spacing patterns as part of the Smithsonian/Nepal Tiger Ecology Project (SMITHSONIAN, August 1978).

A mile and a half down the road her tracks turn off into a narrow, tunnellike trail through the tall grass. As we follow, the thick canes with their sharp leaves swirl around us, towering over our heads even though we are elephantback and sitting ten feet above the ground. The tigress is wearing a radio collar and after an hour of thrashing through this sea of grass, we find her at a rest site along a small stream.

On the way back to camp along the park road, we hear hundreds of people singing, laughing and calling to each other in the tall grass. It is early January and the beginning of the annual 15-day grass-cutting season in Nepal's Royal Chitawan National Park, a time when 100,000 local villagers come from as far away as 30 miles to harvest the tall grasses. Different kinds are used for the roofs and walls of houses, as well as for fences, fishing baskets, torches and even scarecrows. Virtually all of what had once been grassland in this part of Nepal is now under cultivation; three game reserves and this one national park have become the sole source.

Rather than alienate the surrounding population and fight the inevitable grass poaching that would occur, Nepal's National Parks and Wildlife Department has chosen to work with the people instead. For two weeks each year, villagers can come into the reserves and cut as much grass as they can carry; they pay a token fee, imposed only as a simple way of counting the harvesters.

This idea of inviting the local people in rather than locking them out is not only the wave of the future for national parks in the developing countries, it is already becoming the rule rather than the exception. Governments and park managers are moving away from the old philosophy of parks as places set aside from human activity. More and more they are permitting seasonal grazing of cattle, fishing and even some subsistence hunting.

In Nepal's Royal Chitawan National Park, the idea is working. At dawn every day in the cutting season, thousands of people wade the mist-shrouded rivers that form the park boundaries. They walk two or three miles to stake out the best grass, spend all day cutting and stacking, and then walk out again with loads of 65 pounds and more. Whole families work together and they make as much noise as possible, calling back and

A radio-collared tigress, known as Chuchchi during a Smithsonian study, pads along trail in the grass.

Elephant is the only vehicle that can penetrate the tall grass of Nepal's Chitawan National Park.

Cutting and burning in a Nepalese park

Local villagers carry bundles of thatch grass, some weighing as much as 65 pounds, out of the park.

Back home, they use thatch grass to fashion roof of a house over a latticework of heavy cane.

Limited to what they can carry on foot, villagers carry grass across the Rapti River, a park boundary.

forth to one another, to keep away rhinos and bears.

The belt of riverine grasslands in the Himalayan foothills, known as the "terai," formerly extended for more than 625 miles along the southern borders of Nepal, Sikkim and Bhutan. The interfingering of forest and grassland produced a mosaic of habitats where predators and prey reached some of the highest densities on the subcontinent. Greater one-horned rhinos, tigers, leopards, wild boars, five species of deer and three of antelope made it a hunter's paradise. Sparsely inhabited because of malaria and government policy, the terai was also a formidable barrier to travelers. In the mid-1800s the botanist Sir Joseph Hooker described it as "supporting a prodigious undergrowth of gigantic harsh grasses that reached to our heads, though we were mounted on elephants." He added, "These gigantic grasses seem to be destroyed by fire with remarkable facility at one season of the year; and it is well that this is the case; for whether as a retainer

The view is north, across the lowlands of Nepal to the towering ranges of the Himalayas in the distance.

of miasma, a shelter for wild beasts . . . the grass-jungles are most serious obstacles to civilisation."

A malaria-eradication program in the 1950s, combined with disastrous flooding in the nearby hill regions, brought many settlers to the terai; the fertile alluvial grasslands that were so productive of wildlife made ideal farmland. They were flat and easy to clear, the soil could be prepared by bullock-drawn plows, and patches of forest provided firewood for cooking. Now most of the grass is gone; only in the park and reserves do large tracts remain.

For the remainder of January we monitor the radio-collared tigers and watch the people harvesting grass. Villagers cut the shorter roof-thatching grass first and then set fires among the taller species to burn off the outer leaves. The fires roar and crackle, erupting from the grass in dark columns of smoke; the sky rains soot for days. Black drongos swoop around the burning patches, picking off insects flushed by the heat.

After the tall grasses are burned, people return to cut the remaining charred bamboolike canes, which they will use later to build the walls of their houses. Visibility is now much improved and we can see the wildlife return after the fires. First are the rhinos, which appear to seek out burned stalks.

Throughout the cutting season people carry bundles of grass out of the park and stack it in great piles along the riverbanks. As the season comes to an end, the small roads are jammed with hundreds of bullock carts to carry off the harvest.

In camp one night, Hemanta R. Mishra, a government ecologist who took his doctoral degree at Edinburgh University, explains why Nepal encourages the harvest. "First," he says, "for a park system in the

Fiona Sunquist is a British photographer who has accompanied her zoologist husband on studies in Latin America as well as Asia; they live in Florida.

Cutting and burning in a Nepalese park

Grass shoots like this appear ten days after cutting and burning; growth is knee-high in a month.

midst of a densely populated area to succeed in the long term, we must consider the local community in the context of reserve management. Tourism has not been a significant benefit to the local economy. In fact, many villagers complain that it has inflated the price of basic commodities beyond their reach.

"Secondly," he continues, "by allowing limited access to a resource that is central to the region's livelihood, we are able to illustrate a principle of conservation in terms that villagers can understand. They recognize that most of the tall-grass habitats are gone and the reserves are protecting what is left; because of this the reserves have the support of the local community."

He leans forward, putting down one of his ever-present cups of tea. "Finally, grasslands are a successional stage we would like to maintain because they are highly productive in terms of ungulates and consequently for the larger carnivores. This is best accomplished by cutting, burning or grazing as these practices tend to retard the invasion of woody species."

Experts urge a new approach to conservation

Firewood, a critically scarce resource in many developing countries, would not lend itself so easily to similar programs because demand would exceed production in most areas. For this reason, wildlife experts such as Kenton Miller, director general of the International Union for Conservation of Nature and Natural Resources (IUCN), have new advice for conservationists in the wealthier countries. The best way to help wildlife preservation in Africa, Asia or Latin America now, Miller argues, is to support "ecodevelopment" outside the parks. In an *International Wildlife* interview he said: "Support firewood plantation development. Support extension work with local farmers. Support rural education. Conservationists will get more bang for their bucks doing that as part of their action programs than simply trying to save another rhino."

As the cutting season ends in Chitawan, the park returns to normal. It looks as if the ground will take a long time to recover, but because the water table is high the grass grows back quickly. In a few days a glimmer of green appears, and two weeks later the black earth is covered with an emerald carpet. Large herds of chital and hog deer congregate to feed on the new, protein-rich growth. Peacocks grow their breeding plumes and dance for females in the open meadows. A month after the fires, when the grass is knee-high, we begin to locate tigers and the remains of their kills in the grasslands again; there is now enough cover for them to stalk their prey. By the end of April, the grass is as high as an elephant's eye.

Greater one-horned rhinoceros grazes in the park: availability of grassland is crucial to its survival.

The cub of a radio-collared leopard drinks at water hole. A small population lives in the park.

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By A.B.C. Whipple

Stranded Navy man who charted the world's seas

Lieutenant Matthew Maury compiled the first scientific wind-and-current guides from nearly a century of dusty logbooks

Photograph of Maury was made as he planned the first international conference on maritime meteorology.

One of the most significant events in maritime history occurred not at sea but about 400 miles inland in the middle of Ohio one dark night nearly a century and a half ago on the evening of October 17, 1839. Riding atop the overbooked stagecoach out of Lancaster, a young naval lieutenant was tossed to the ground as the coach sank into the soft shoulder of a muddy detour and overturned. He was taken to a town which had no hospital, and so was put to bed in the local hotel where a doctor diagnosed major injuries: a broken thighbone, a dislocated knee and a torn ligament in the kneecap. The doctor did a sloppy job of setting the thigh, and another doctor had to reset it, all without anesthetic. The young man was by now so crippled that he was confined to the hotel for three months before he could resume his journey—three months during which he could contemplate a dark future as an officer in the U.S. Navy. He could never have guessed, at the time, what an auspicious incident the accident would prove to be.

His name was Matthew Fontaine Maury. He was 33 years old and had had a promising career in the Navy, until now. The son of an impecunious farmer in Tennessee, Matthew showed an early aptitude for mathematics and science, and was urged by his high school teacher to continue his education in these fields. The U.S. Navy appealed to young Maury as the best, and least expensive, way to do this. In fact, the Navy had already attracted him because his older brother John had joined up and returned home for a visit with glowing accounts of adventures in the South Seas. But John had later died of yellow fever, and Matthew's father had forbidden him to follow his brother's example. Matthew nevertheless applied for midshipman training and was accepted. When he left home on a horse purchased on credit from a neighbor, his father turned his back and refused even to wave good-bye.

Midshipman Maury proved an adept naval officer from the start. On an early cruise to the Pacific, he was transferred to the *Vincennes*, which was en route to becoming the first U.S. Navy vessel to sail around the world. Maury was fascinated with navigation; his shipmates recalled him chalking problems in spherical trigonometry on the round shot in the racks on deck while the rest of the midshipmen were lolling in the warm Pacific sun.

He was also a brash, self-confident young man. When Maury took his examination for promotion from midshipman's rank, he contradicted the senior officer conducting the exam. Confronted with a lunar

Maury memorabilia at the Virginia Military Institute: his books, sword and a model of the *Flying Cloud*.

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The *Flying Cloud* broke the New York-to-California record with Maury's charts.

problem from Nathaniel Bowditch's hallowed *The New American Practical Navigator,* Maury strode to the blackboard and demonstrated with his own trigonometric solution that Bowditch had got it wrong. The examiner, unable to follow the calculations, declared Maury in error. Maury insisted that his answer was the correct one. As a result, he was given a low position on the promotion list, which added two years to his wait.

The arrogant young midshipman had not only questioned his senior officers, he had done much worse: he had challenged the Bible of the U.S. Navy. Bowditch was Holy Writ to his superiors. But from his first reading of Bowditch, Maury had found fault with it; characteristically, he reacted by writing his own book. In 1836 he published his *A New Theoretical and Practical Treatise on Navigation.* It was acclaimed by reviewers, including Edgar Allan Poe, then editor of the *Southern Literary Messenger.* But Maury was most gratified by the reaction of Nathaniel Bowditch himself, who recommended Maury's book as a replacement for his own as the standard Navy text for midshipmen. (It was eight years before the Navy made the change.)

Maury had meanwhile added more experience to his studies. Assigned to the sloop-of-war *Falmouth* in 1831, he was designated as acting sailing master, which meant that he navigated the warship on a voyage around Cape Horn to South American ports.

He published a study on the navigation of Cape Horn, full of unorthodox suggestions for weathering the storms and crosscurrents, in July 1834; the same month, he married a distant cousin named Ann Herndon.

In June 1836 he was at last promoted, and seemed at the threshold of a distinguished career. Then, in October 1839, he made a visit to his boyhood home in Tennessee, to be greeted by a proud father who had long since forgiven him. It was while he was returning to sea duty aboard his ship in New York that the stagecoach sent him, and his promising career, crashing to the ground.

There was little chance, he realized, for further promotion for a naval officer who could not get about on a pitching deck. During his slow recuperation, Maury penned a series of newspaper articles advocating a variety of reforms in the Navy. He championed a Naval Academy similar to the Army's Military Academy at West Point, proposed that the Navy save money by retiring surplus admirals to a half-pay "Reserve List," and accused the Board of Navy Commissioners of collusion in a graft-ridden scandal involving building and repair of naval vessels. Maury wrote under a pseudonym, but his identity was smoked out. And the brass retaliated with what very quickly became a deliciously ironic reprisal.

Of all the backwaters in the U.S. Navy, one of the most obscure was the Depot of Charts and Instruments, established only 12 years earlier and managed by the then superintendent in his own home. Its chief function was to check the time: with a telescope, the superintendent made ob-

A.B.C. Whipple's last article for SMITHSONIAN, *in the September 1982 issue, was about hurricanes.*

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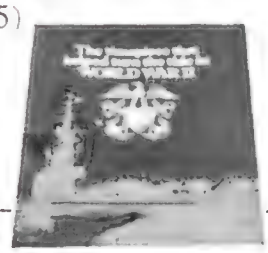

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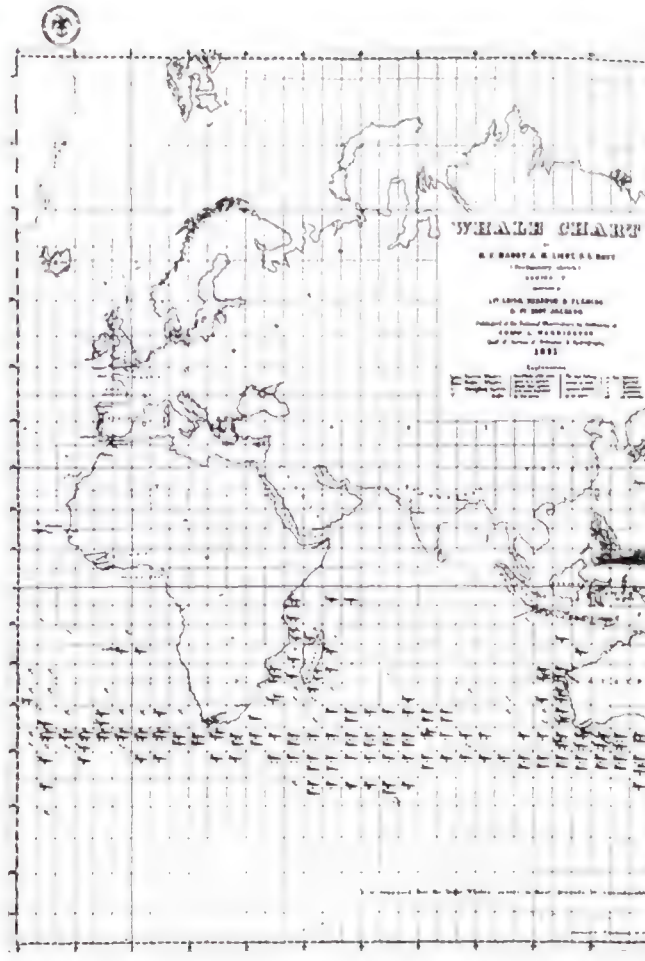
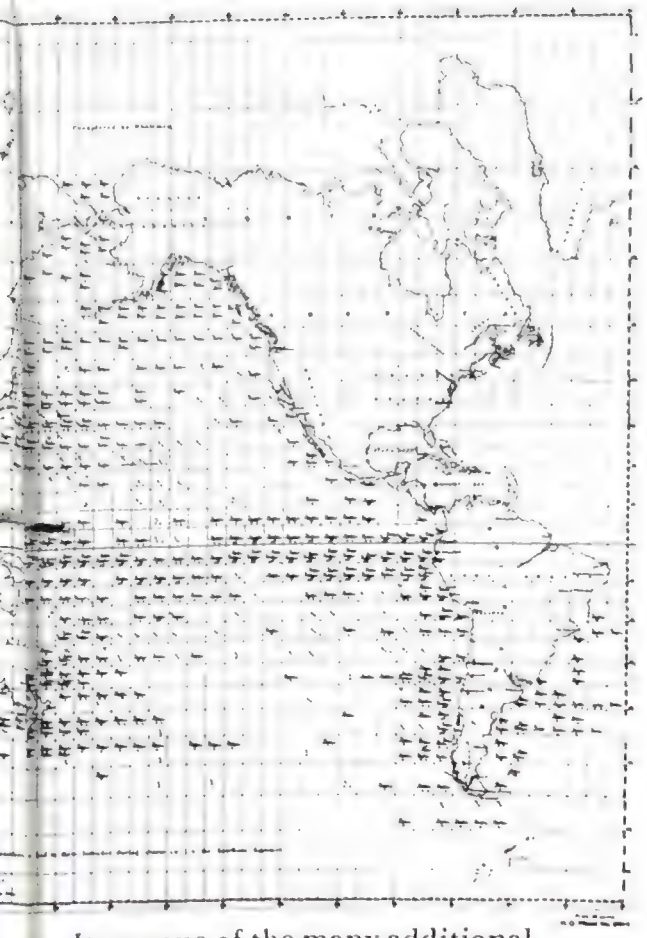


Whale chart prepared by Maury was published by the U.S. Naval Observatory.

servations of the sun and stars over Washington's meridian, thus determining solar and sidereal time for the Navy's chronometers.

To the angry admirals this must have seemed the ideal internment—if not interment—for the sassy young lieutenant. There may also have been an admiral or two who with longer vision saw the depot's superintendency as the appropriate role for a specialist in the science of navigation.

For his part, Maury accepted the new post with pleasure. By now he was off crutches, but he still limped, as he would for the rest of his life. And he had chafed for nearly three years while awaiting further orders, even though he knew that they came slowly in the peacetime Navy. He reported for duty on July 4, 1842. He promptly found new quarters for the depot, including an apartment for his family, and moved in the instruments and other paraphernalia. And it was amid this paraphernalia that Maury made the discovery that changed maritime history.



It was one of the many additional benefits of gathering maritime data.

Gathering cobwebs in the depot's archives were thousands of logbooks; Navy regulations stipulated that every captain at the end of each voyage send his logbook to the depot for safekeeping. Ever since the American Revolution the volumes had piled up, and no one had figured out what to do with them. Maury did instantly.

Here, in page after page, shelf upon shelf, were the observations of countless navigators on all the oceans of the world at all times of the year over more than half a century. The logbook was where the skipper or his executive officer noted the conditions of the sea and the wind for every day of the voyage. These moldy volumes thus comprised an encyclopedia of information about all of the seas the U.S. Navy had covered. It was a navigator's dream. And all Maury and his staff had to do was collate it.

Moreover, the need was there. From his own experience as a navigator, Maury knew the limitations of the charts then in use by the Navy. These maps of the sea generally pro-

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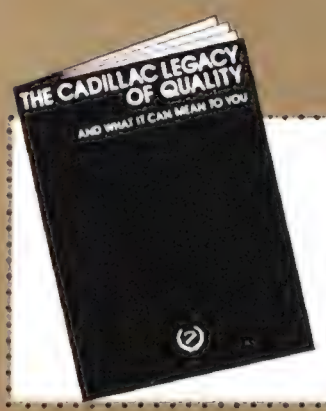

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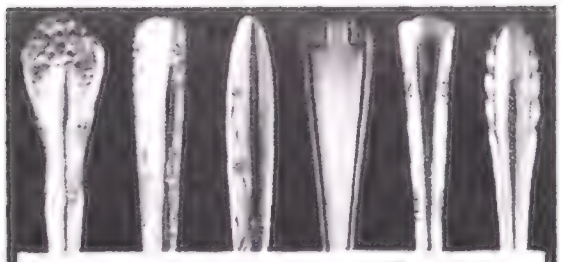

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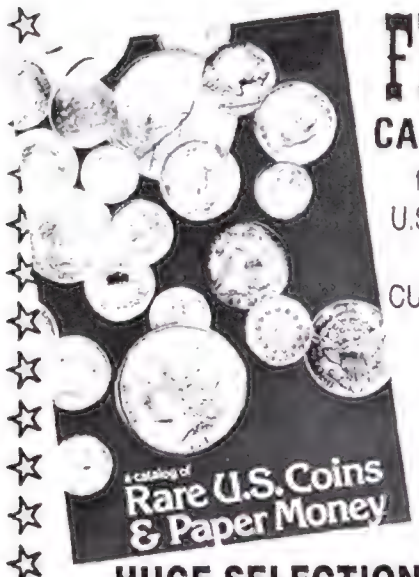

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vided little more than depth soundings, with hardly any information on such all-important phenomena as currents and the direction and velocity of the wind. Nor were they even American charts. As Maury pointed out to the Secretary of the Navy, the United States still relied for most navigation on other nations' surveys, even in local waters. "The charts used by an American man of war when she enters the Chesapeake Bay," he wrote, ". . . are English and we are dependent upon the English Admiralty for them." In 1842, he did not need to add that the United States had twice been at war with England in the past 70 years.

Maury and his staff immediately started coordinating the data in the logbooks. Gradually the daily records were reassembled under geographical headings, and Maury's revolutionary guidebook began to take shape. The new charts, he explained, were "intended to generalize the experience of navigators in such manner that each may have before him, at a glance, the experience of all."

But he needed more records. Some log keepers, Maury found, were more meticulous than others, and there were gaps in the big jigsaw puzzle he was assembling. Maury persuaded the Navy to issue blank charts to all its vessels and to request all captains to fill them in and return them to the depot. By 1847 the Navy published Maury's first *Wind and Current Charts*, covering the North Atlantic. For most of this ocean the volume revealed what previous navigators had encountered: the range of wind forces, their direction, the state of the seas at various times of the year, the currents, the prevalence of storms, of calms, of fog.

More than a compilation of all this information, Maury's volume transformed it into easily understood symbols. On each chart of the ocean, winds were indicated by hundreds of tiny brush-shaped figures; the head of the brush pointed in the direction from which the wind came, and the length of the brush denoted the comparative force of the wind. Arrows indicated currents, with figures alongside each arrow showing the current's speed in knots. The charts also were dotted with underlined figures denoting the temperature of the water at points throughout the ocean.

Maury's findings offered some surprises. The stormiest waters of the world, for example, were not off Cape Horn but in the winter North Atlantic. Another myth among merchant skippers was that the best route south to Rio de Janeiro was well outside Brazil's jutting Cape São Roque. Once inside the cape, they warned, you would get swept inshore by hazardous currents. Some captains nearly crossed the Atlantic all the way to Africa in order to avoid Brazil's cape. But Maury found—largely from the logs of skippers who had blundered inside Cape São Roque—that there were actually favorable currents that could be ridden out around the cape, and helpful winds close to land to add to a vessel's speed. His advice, then, was to ignore the old warn-

On brink of the Civil War, Maury was photographed by Mathew Brady, c. 1860.

Nita Franks had no insurance, no savings and a very sick child.

On May 31, 1983, Nita Franks, a part-time pecan sorter in Corsicana, Texas, carried her extremely weak son into the emergency room of Navarro Regional Hospital, one of over 380 hospitals owned or managed by Hospital Corporation of America and its affiliates.

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Like many rural hospitals, a large part of Navarro Regional's patient load is indigent care. The resulting financial burden had kept the old county hospital in the red for years —to the point of almost losing accreditation. But with financial support from the sale of the hospital to HCA, an innovative solution was found: The Navarro County Health Services Foundation.

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Nita Franks and her son Courtney, Corsicana, Texas.

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ings, and instead to "tack, and work by under the land."

Using Maury's charts, a captain named Jackson took his bark *WHDC Wright,* deeply laden with a cargo of flour, from Baltimore to Rio in 38 days—17 days faster than the usual time. On the return voyage, with a hull full of coffee, Jackson chopped 18 days off the normal run.

The story spread up and down the waterfronts of the entire East Coast. Suddenly every captain, and every thrifty shipowner, wanted a copy of Maury's *Wind and Current Charts.* Maury's new contribution was perfectly timed: the age of the American clipper ship had just begun.

It was an age spawned by the Gold Rush of 1849. For about half a decade, the tea clippers had been racing to China. Now these graceful vessels were being replaced by big, strong clippers for the run to California. They were sturdy mammoths built for the crashing seas off Cape Horn, designed long and lean to slice through rather than pound over the waves. Their primary purpose was not to take the Forty-Niners to the goldfields; by the early 1850s, it seemed as if half the population of America was already there. The California clippers were freighters, specially built to deliver desperately needed provisions—tools and tents, furniture and food—to the other side of the continent as quickly as possible. With flour bringing $50 a barrel and eggs $1 each, the winning shipowners in this race made far greater fortunes than the miners digging in California's hills.

A lithograph depicts the laying of the Atlantic cable at Newfoundland in 1866. Maury's work assisted Cyrus Field in historic linking of continents.

The most spectacular use of the charts came almost immediately. On June 2, 1851, the new clipper ship *Flying Cloud* (p. 172) set out in a fresh westerly from New York harbor, bound down around the Horn to San Francisco—carrying Maury's *Wind and Current Charts.* The average sailing time for this 15,000-mile voyage was four to five months. Eighty-nine days and 21 hours after leaving New York, the *Flying Cloud* roared up to San Francisco's Golden Gate. Using Maury's charts, the ship paid for its entire purchase price of $90,000 by the time it returned to home port.

Hundreds of the other skippers also used the *Charts* and their accompanying *Explanations and Sailing Directions.* And the combination of slim, sleek clippers and the new charts lowered the average time over this tempestuous course by more than a month. As the requests for his charts poured in, Maury responded with a tempting bargain: any merchant captain who took along Maury's abstract logs, filled them in and returned them could have a free copy of the next edition of *Wind and Current Charts.* By the end of 1851, more than a thousand skippers were sending in their abstracts. And Maury and his staff had enough information to produce charts of all the major seas.

Besides indicating the most efficient tracks across the world's oceans, Maury's rapidly expanding series of volumes covered the trade winds, Asia's monsoons, ocean currents and temperatures, and even a set of charts for whalemen indicating the migrations of their quarry.

It was while compiling the whale charts that Maury made another significant observation. For more than two centuries, explorers had been trying to find the fabled Northwest Passage from the Atlantic to the Pacific across the top of the world. It was Maury who realized that the whales had already found it. Writing to Baron Alexander von Humboldt (for whom the Pacific's Humboldt Current was named), Maury reported that some whales taken in, say, the western Arctic Ocean carried the broken-off harpoons of whaleships that had hunted only in the North Atlantic. Must this mean, he conjectured, "that there is occasionally a water communication from strait to strait—in other words a northwest passage?" A few years later his assumption was confirmed when the British explorer Sir Robert John Le Mesurier McClure finally found the northern waterway between the two oceans.

Like the migrating whales, skip-

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pers who strayed into uncharted areas helped Maury point out new, shorter routes. British shipowners found that with Maury's help their vessels were cutting weeks off their Far East passages, at substantial savings per voyage. Maury's charts and advice aided American ships in cutting their round-the-world passages by a third of the usual time. No wonder that mariners everywhere began calling Matthew Fontaine Maury the "Pathfinder of the Seas."

With his abstract logs pouring in from navigators all over the world, Maury persuaded the U.S. Navy to sponsor the world's first International Maritime Meteorological Conference. It convened in Brussels in August 1853, attended by representatives of ten nations, who voted unanimously to establish an international system of exchange. All the nations would share their abstract logs and other maritime and meteorological observations, and Maury would provide everyone with his charts.

In the half-century after the Brussels conference, Dutch navigators alone filled in 3.5 million abstract logs; British mariners sent in 7 million, and the Germans, 10.5 million, to add to the Americans' 5.5 million. Matthew Maury had almost singlehandedly brought navigation into the modern age, changing nearly every captain's traditional hunch and guesswork to scientific observation.

Worldwide acclaim, however, did not automatically translate into personal wealth for an officer in the peacetime U.S. Navy. Partly at Maury's urging, a Naval Observatory had been built, and in 1848 he had been given the title of Superintendent of the Marine, along with a raise in annual salary to $3,000. He needed it. He and his wife already had three daughters and three sons to provide for. He was receiving no royalties for his world-famous charts, and indeed urged the Navy to give them away to navigators around the world in return for their information to include in more charts and to update the ones the Navy had issued.

Finally, in 1854, Maury set out to improve his finances by writing a

In London with family after war, Maury sits for camera with his wife and granddaughter; children and a Dutch friend (second from left) stand.

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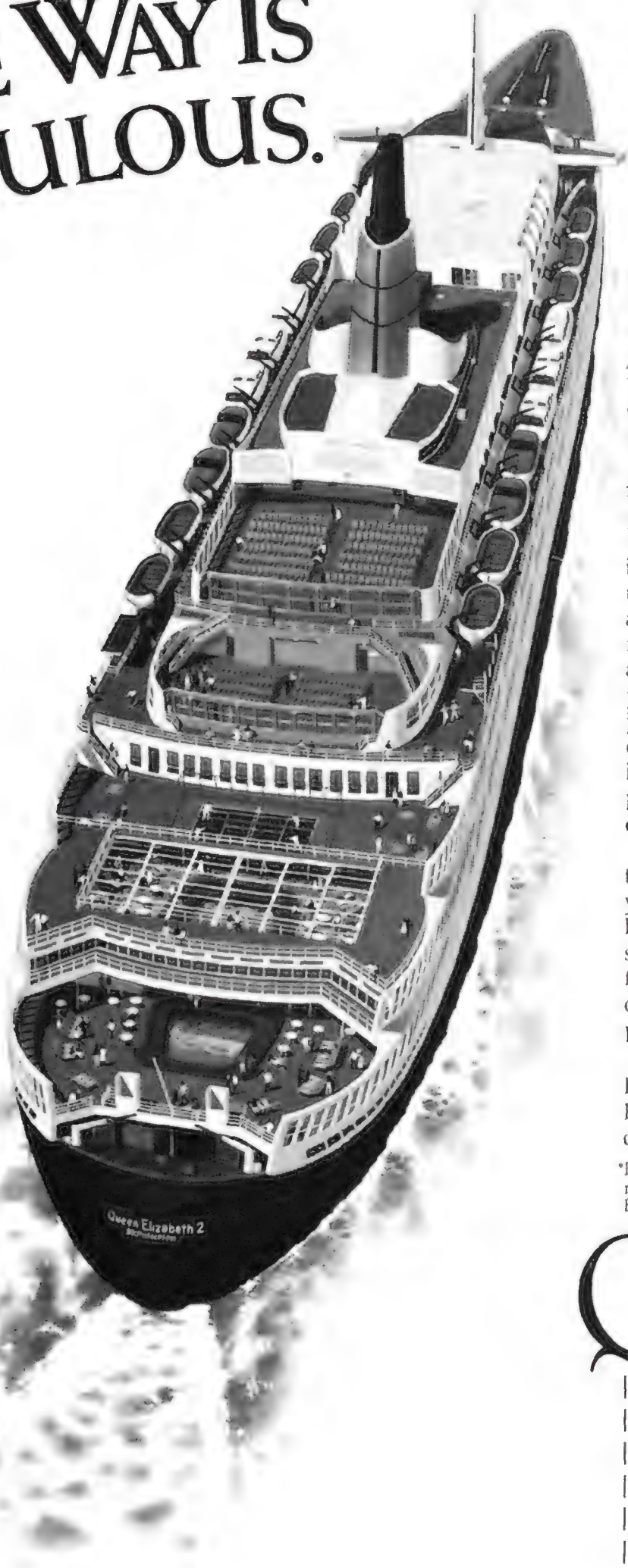

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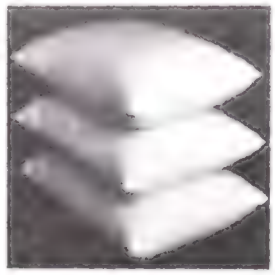

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book on his own, in what spare time he could find from his work. A statement by Maury's fellow scientist von Humboldt had suggested a title: *The Physical Geography of the Sea.* The book was published early in 1855, to acclaim from general reviewers—and criticism from many scientists.

Some of the scientists disagreed with conclusions that were based on insufficient evidence—and that did prove to be wrong in succeeding years. Maury claimed incorrectly, for example, that winds had little to do with ocean currents.

Nevertheless, *The Physical Geography of the Sea* made oceanography understandable to Everyman. The book was an instant best seller and was translated into half a dozen foreign languages.

Maury was not one to rest on his laurels as the father of modern oceanography. He was active in helping Cyrus Field lay the first transatlantic cable. He also campaigned vigorously for a U.S. Weather Bureau, a near equivalent on land of the service his observatory was providing at sea. He campaigned in vain; in a nation rapidly dividing between North and South, Congress was in no mood yet for a nationwide weather service.

But other Maury proposals were being realized. The Naval Academy that he had advocated as early as 1840 was established in 1845. (Today one of its buildings is named Maury Hall.) And Maury's early call for retirement of superannuated admirals finally resulted in a Navy reform bill that was passed by Congress—with the help of some lobbying by Maury—in 1855. One of its provisions was the appointment of a review board to indicate which officers were "incapable of performing promptly and efficiently all their duty both ashore and afloat," and to relegate them to a Reserved List at half pay. To his surprise, the review board's first list included the name of Lt. Matthew Maury.

He was ordered to continue his work as Superintendent of the Ma-

After his exile in England, Maury posed in Richmond, Virginia, in 1868.

rine, but officially he was removed from active duty—and reduced to half pay. The irony of the situation only added to Maury's outrage. He demanded a Court of Inquiry. It took an act of the Senate to force a final resolution on the reluctant Navy. The bitter battle lasted more than two years, and finally the Naval Affairs Committee was forced to recommend reinstatement of Maury's status and salary. But the affair turned out to be a portent of worse to come.

Tension was mounting between the Northern and Southern states, and when in 1861 Maury's home state of Virginia seceded from the Union, the Superintendent cleared his desk, turned over his sword and the care of the observatory to his deputy, wrote out his resignation from the U.S. Navy and sent it to President Abraham Lincoln. In April 1861 he crossed the Potomac to join the Confederacy.

Maury disapproved of slavery. But he considered himself a Virginian, and could not bring himself to fight against his own state and his many Southern relatives. His family settled down in Fredericksburg, Virginia, and Maury was made a Commander in the Confederate Navy, and in 1862 he was ordered to cross the Atlantic and report to Capt. James D. Bulloch,

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the Confederacy's Secret Service chief in England, who was purchasing and outfitting vessels to serve as Confederate raiders.

For the next three years, Maury scouted British shipyards for likely raiders. When he found one, Bulloch would purchase it through a neutral agent. In May 1865, Maury boarded a steamer to return home with $40,000 worth of new torpedoes to be used against the Union warships blockading Galveston harbor, one of the few ports still in operation as the Confederate forces retreated. When the steamer put into Havana, Maury found that the Civil War was over.

Convinced that he could not yet go home because of his work in the Confederate Secret Service, Maury went to Mexico, then under French occupation, and concocted a plan to persuade Southern plantation owners to leave their ruined cotton fields and start over again in Mexico; now-freed slaves could come along as "apprentices." Napoleon III had installed the Austrian Archduke Maximilian as emperor, and Maximilian, who had earlier complimented Maury on his scientific work, now grandly appointed him to act as Imperial Commissioner of Immigration.

But nothing came of the plan, so Maury wrote his wife asking her to take the family to London; he met them there in March 1866. The Pathfinder of the Seas was 60 years old, financially insolvent and disgraced in his homeland. He tried to make a living by starting a torpedo-training school for British naval officers; however, it failed.

At last, in 1868, President Andrew Johnson declared a pardon that removed the threat of execution. Maury and his family had already set out for home. The Virginia Military Institute in Lexington had offered him a post as a professor of physics, at a salary of $2,000 a year, which he supplemented with lecture tours.

He continued to pursue a number of projects: an agricultural school in

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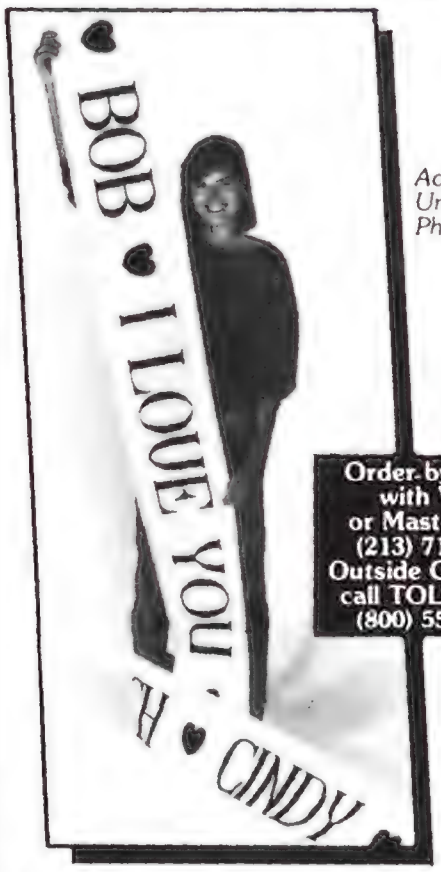

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Virginia (later realized in the form of the Virginia Polytechnic Institute); a geographic survey of the state; and his longtime favorite, a national weather bureau. In the latter cause, he set out for Norfolk, Virginia, where he planned to make a speech, but he collapsed in Fredericksburg. When he finally made his way home to Lexington, he said to his wife, "My dear, I am come home to die"—which he did on February 1, 1873.

His grave is in Richmond, Virginia, near that of James Monroe, who had been President when Maury became a midshipman. Not until ten years after Maury's death did the U.S. Navy resume issuing his *Wind and Current Charts.* Then—and today—they carry the somewhat grudging acknowledgment: "Founded upon the researches made in the early part of the nineteenth century by Matthew Fontaine Maury."

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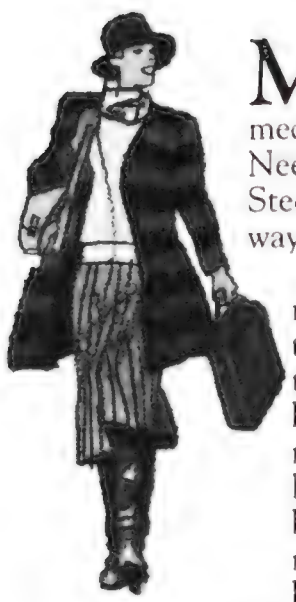

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Book reviews

A New Birth of Freedom: Lincoln at Gettysburg
Philip B. Kunhardt jr.
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There are those events and individuals that rise so far above themselves in the popular mind that no book can do them justice. More biographies of Abraham Lincoln have been written than for any other man with the exception of Napoleon. There have been a number of books, too, about his Gettysburg Address, the most lauded speech in history. None of them has proved entirely equal to the subject. Indeed, it is perhaps an impossible task.

Kunhardt finds in Lincoln's reading the origins of phrases and cadences that characterized his public speaking. In the books of the Old Testament, the Declaration of Independence and the works of public men like Daniel Webster and Theodore Parker lie sparks that later blazed in Lincoln's speech.

The account of the day of the address itself might make some argue that it is unnecessarily padded—that four pages of what was appearing in the national press that day, or nine pages on Lincoln's daily office routine, are hardly necessary. Kunhardt seeks to re-create the entire milieu in which Lincoln spoke.

As eloquent as the words in the Kunhardt book, of course, are the photographs. The images here are mostly familiar, but all of them are rich. Unlike so many illustrated books on the Civil War era, this one's photographs are well and properly identified. Kunhardt has done especially good work in addressing the identification of the individuals who

are shown in the one image we have of the speakers' stand.

And the book concludes in a valuable appendix that reproduces and compares line-by-line the seven contemporaneous texts of the speech, five from Lincoln's hand and two by others present. The wording of the speech that has come down to us is largely a consensus drawn from several slight variations, and no one today can say with certainty precisely which words Lincoln spoke that day.

Kunhardt's is a notable effort. Seeing the Gettysburg Address as the epitome of all that Lincoln felt and stood for in his life, he starts on a road that begins with Lincoln's birth and only ends as Lincoln laments after the speech that "I failed, I failed." Unfortunately, much of that highway is rutted with error, and it should not have been so. After all, Abraham Lincoln has been something of a family interest with Kunhardt, his mother, Dorothy Meserve Kunhardt, and his grandfather Frederick Hill Meserve, before him.

The problems arise in Kunhardt's portrait of Lincoln's life prior to November 19, 1863. For this is essentially Carl Sandburg's Lincoln. Sandburg is great literature, but rather shoddy biography, and far too many of the discredited canards that he popularized are present in *A New Birth of Freedom*.

We have Dennis Hanks' homey first-person account of his cousin Abraham's birth, for instance, although Hanks never met him until Lincoln was eight. The

An 1857 portrait by Alexander Hesler; Lincoln said he mussed up his hair so that his friends would recognize him.

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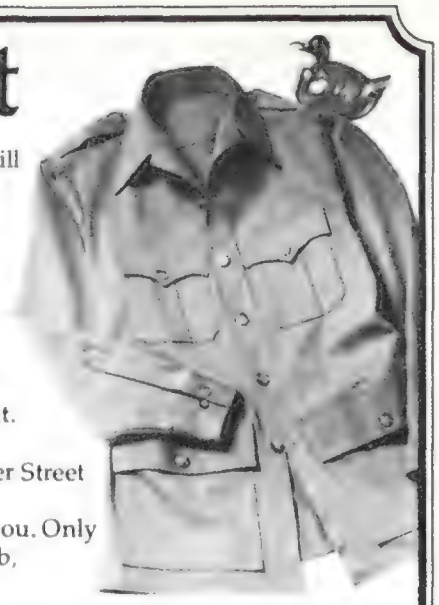

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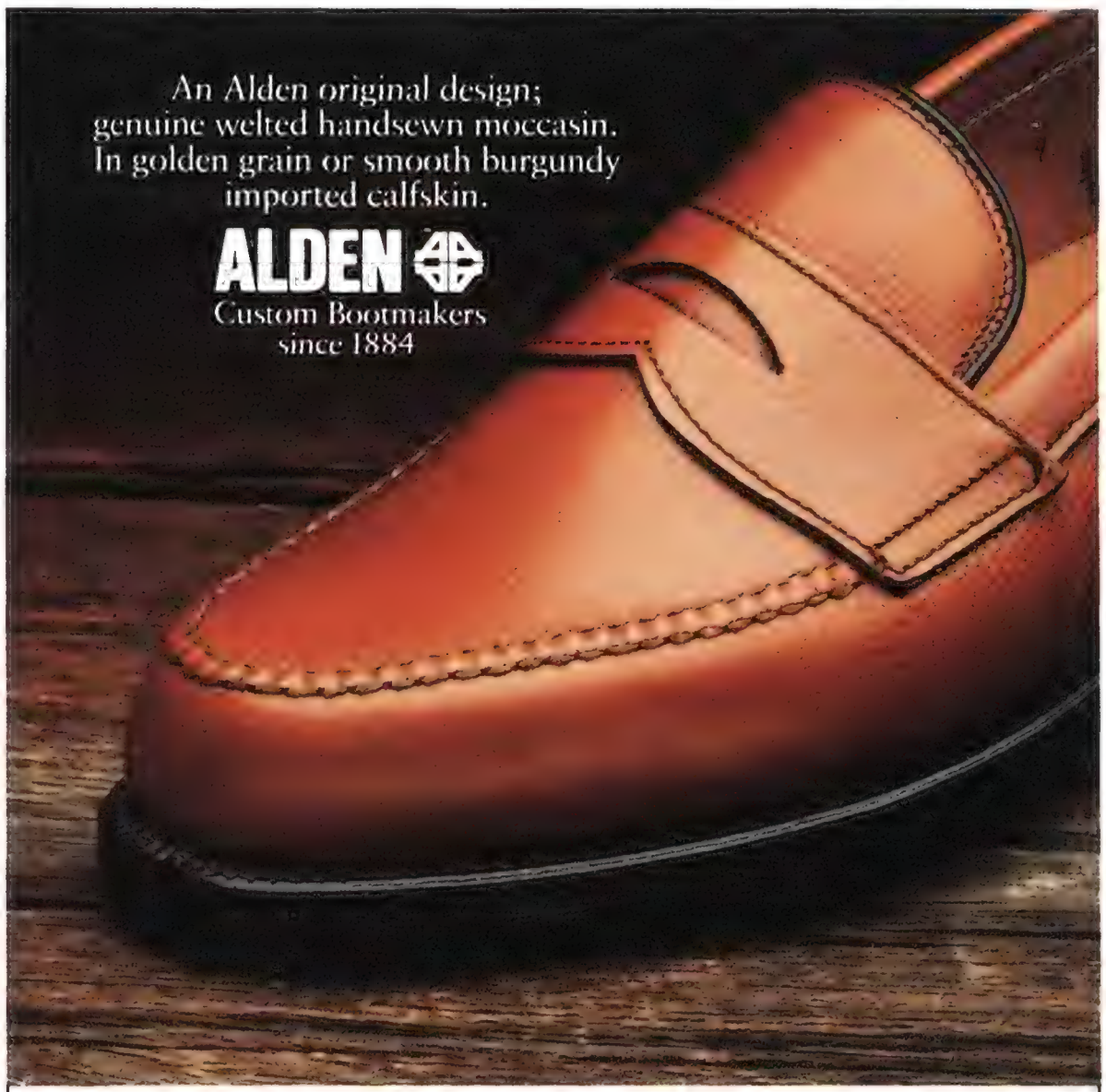

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myth of Lincoln's involvement with Ann Rutledge has been exploded for more than 50 years, yet here it is repeated. The old business of Stephen A. Douglas being a rival for Mary Todd's hand is resurrected, and the very unflattering portrait of Mary Todd Lincoln herself owes too much to the largely fictional rantings of William Herndon, who despised Mary.

Despite the undistinguished nature of the "biography" itself, the *picture* of Lincoln that emerges is still a good one, fair and on the mark, and written with a style and sensitivity that make such a sublime expression as those words at Gettysburg seem to be a natural outgrowth of the man.

Inevitably one must face basic questions. Is a two-minute speech really worth a 263-page book? When that speech is one of the greatest masterworks of oratory, the answer must be Yes. Is this book worthy of such a speech? Despite its shortcomings, it seems unlikely that we shall see, or need, anything better than *A New Birth of Freedom.*

William C. Davis
Historian and editor of the six-volume
The Image of War 1861-1865

No Nice Girl Swears
Alice-Leone Moats
St. Martin's/Marek, $9.95

This saucy guide to etiquette for jazz-age debutantes shocked polite New York society when it was first published 50 years ago. But the book went on to be a best seller for 14 years. The 50th anniversary facsimile edition may bother some readers with liberal social consciences, but much of Alice-Leone Moats' no-nonsense advice on how to behave in nice company is surprisingly still up-to-date.

It is a fascinating bit of social history, reflecting without pretense the frivolity and egocentricity of a segment of 1930s American society, wealthy and lucky enough not to have been devastated by the Great Depression.

This is very much a book of its time and a reflection of the social standing of its author, who undertook it as somewhat of a sport a year after her social debut. The daughter of wealthy expatriates, Miss Moats devoted nearly one-third of her book to the niceties of coming out in upper-crust New York without once mentioning the economic disaster that engulfed most of the nation. "Nobody was

thinking in terms of that" in the 1930s, she says.

Miss Moats made her debut in the days of Barbara Hutton, heiress to the Woolworth fortune, who spent more than $20 million in the decade after 1933. Such young women attended debutante dinners and balls while crowds of poor New Yorkers stood by in the hope of catching a glimpse of a glamorous spectacle.

But this book has to do with social relationships and not social conscience. It purports to be a guide to how people ought to treat each other, but in reality it is more concerned with how to avoid boors and attract scintillating company.

At the beginning of her guide, Miss Moats establishes her social credo: "Do as you please *if* you can get away with it." She wraps up her advice with a full chapter on how to handle a drunken date: "When your companion passes out in a taxi, get out at your own house, give the driver the young man's address, and think no more about him. Of course, if you should be very annoyed, you might tell the driver to take the lad to Yonkers. . . ."

At the age of 19, she delivered herself of such sagacities as: "Nothing puts a man off like conversation" and "Don't flirt with your hostess's husband . . . and don't make scenes with the lady who is making a play for your husband."

Miss Moats spent six years trying to overcome the stigma of the success of *No Nice Girl Swears*. It was not until 1939 that she won assignments to write material more weighty than required by the women's pages. But she was as determined as she was unconventional, and as a free-lance writer she became one of the earliest women correspondents in Asia, Europe and Africa. In Spain, she put CBS radio back on the air after a seven-year hiatus. In 1944 she walked over the Pyrenees into Nazi-occupied France and reported front-page stories that appeared in several American newspapers. Today, well past 70 (she never trusts a woman who tells her age and Miss Moats doesn't tell her own), she still writes an op-ed column in the *Philadelphia Inquirer*.

In a new introduction, Miss Moats acknowledges the passing of social frills such as engraved calling cards and formal balls. She asserts that good manners still very much have their place, and tosses off "Me"-generation objections that politeness is insincere. "I expect a man to

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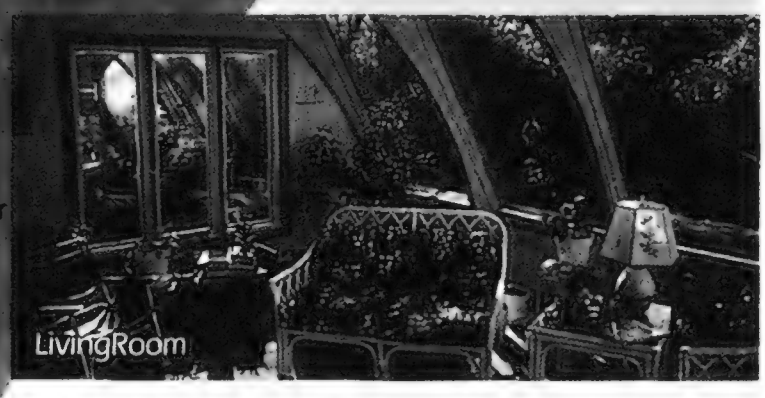

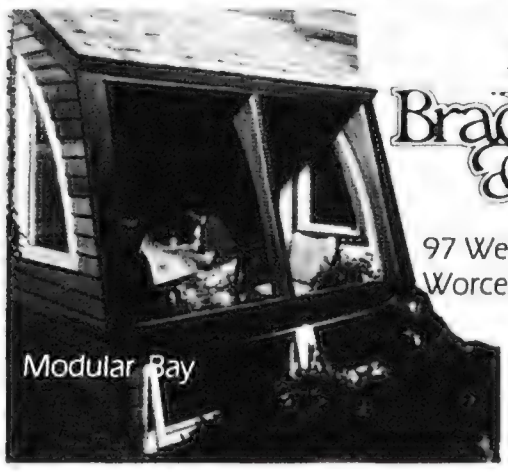

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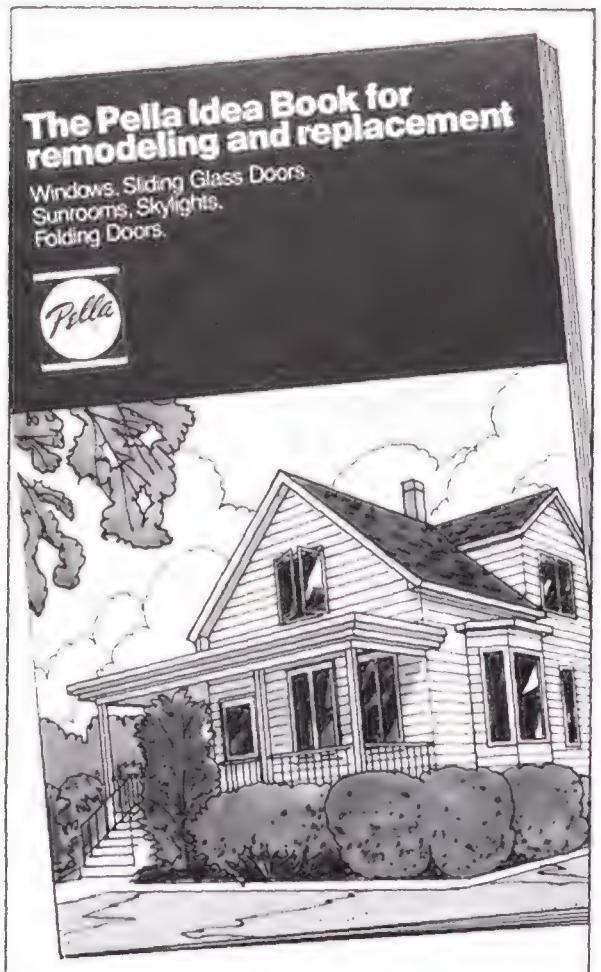
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have the courtesy to step aside and let me go through a door ahead of him," she writes, "but I don't demand that he do so because he is ready to lay down his life for me."

She observes that today's young women have abandoned the tendency toward sexual promiscuity and have taken to fending off passes from overly arduous suitors just as girls did in her own youth. And she insists that by addressing new acquaintances formally as "Mr. Jones" or "Miss Smith," we introduce at least the possibility for subtle shadings in our relationships, an impossibility for those who leap immediately into first-name friendships with everyone they meet.

The re-edition of *No Nice Girl Swears* and the recent appearance on best-seller lists of *Miss Manners' Guide to Excruciatingly Correct Behavior* (by Judith Martin, Atheneum) signal a revival of interest in older forms of behavior. Indeed, they may even be a sign that we have recovered at last from the moral laxity of the free-form "Me" generation.

"It shows kids are wanting to be civilized rather than savages," Miss Moats says. "You can't live without etiquette."

Suzanne Green Staples
Washington-based writer

Siegfried Sassoon's Long Journey: Selections from the Sherston Memoirs
Edited by Paul Fussell
Oxford University Press, $19.95

In this handsome book, Paul Fussell has produced a brief, fierce memorial to Siegfried Sassoon (1886-1967), the English poet and novelist. Sounding the themes of his much-praised study, *The Great War and Modern Memory* (1975), Fussell portrays Sassoon as an archetypal figure, the dreamy Edwardian who emerged from World War I as an angry spokesman for the modern sensibility.

Hemingway and Remarque built careers around the polarities of life before and after the war; Sassoon never quite escaped its traumatic hold. His poems and fictional trilogy, *The Memoirs of George Sherston* (1928-1936), deal with shell shock, the delayed stress syndrome that bars ex-soldiers from daily life and compels them to relive combat horrors.

Every war is mad, but the Great War seemed to give this entire century the bitter legacy of schizophrenia. Sassoon grew up in a rural world of hunting and

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Siegfried Sassoon was a lieutenant in Royal Welsh Fusiliers in World War I.

cricket; in France he found a "life-denying region" of mud and mangled bodies. The machines of his war ignored bravery: mortars and gas killed at random, with no respect for rank or previous acts of valor. He was spared further combat by a serious wound—inflicted mistakenly by a fellow Briton. Sassoon's sardonic response: "The outcome was absurd, but logical."

Fussell arranges this somber tale with luminous clarity, excerpting passages from the Sherston Memoirs and providing necessary splices of commentary. His brief essays on official blunders and homicidal patriots all serve to verify the sensibility that Sassoon was developing: crisp, ironic, attentive to concrete particulars rather than empty abstractions. Fussell also inserts some of Sassoon's war poems; their spare language indicates how literary discourse changed between the generations of Kipling and Eliot.

Above all, the many photographs Fussell has assembled provide this book with its tone of dark eloquence. The pictures do not illustrate Sassoon's text, nor should they; these scenes instead confirm the artistic validity of his personal account. Linked closely to the text are grainy images of troops moving into combat or idling away long hours in sandbagged trenches, of mighty forests blasted into splinters, of propaganda from the home front—posters, songs, ads—that seems insanely sentimental.

Sassoon and his generation discovered that the old imperial consciousness was

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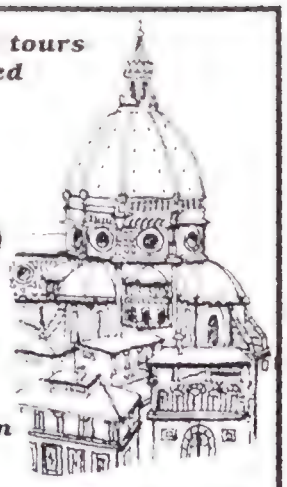

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dying, grotesquely and obscenely smothering in its own corpulence. The war was suicidal, played out in "a dreadful place a place of horror and desolation which no imagination could have invented." And yet this apocalypse gave new life to the modern imagination. In his struggle to comprehend memories of grievous loss, Sassoon captured an image of the new writers who were coming on: "We seemed to be walking in a waste land where dead men had been left out in the rain."

Reading Paul Fussell's elegant interpolation of these words and pictures, we can see how fully the Great War became a lasting memory to us all.

William Howarth
Professor of English
Princeton University

Everett Ruess, A Vagabond for Beauty
W. L. Rusho
Gibbs M. Smith, $15.50

Everett Ruess was a budding artist and writer from Los Angeles who was enchanted, like many another romantic youth, by the patches of white that persist on maps of the American West. To him the foaming streams of the Sierras and the gold-and-lavender canyons of southern Utah were the essence of the grandeur and mystery of life, the reason for his existence. In 1930, when he was 16, he set off on the first of several solitary rambles through the Western wilderness. His mission was to paint the beauty he saw and also, in the tradition of questing young artists, to soak up experience, perhaps to find himself. On November 19, 1934, he camped with two sheepherders in the red-rock canyon country near Escalante, Utah, moving on two days later. He was never seen again. Everett Ruess was 20.

The intent of this modest book is to evoke Ruess, and the wilderness he cherished, through the pathetically few letters, sketches and other writings he left behind. It is a legacy the more poignant for its brevity, a suggestion of what he could have been as much as a portrait of what he was. His letters display flashes of brilliant description and a remarkably mature sensibility amid the adolescent accounts of his ever-tenuous finances. In a 1931 budget report he recorded his expenses—and some that he was spared: "Rent, nothing. Electricity, nothing. . . . Retirement assessment, nothing. . . .

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The only currency he coveted was sensory experience, the glorious surprises that waited beyond the next ridge. "I am always being overwhelmed," he wrote. "I require it to sustain life." His sustenance came in adventures like his nighttime climb out of the Grand Canyon: "A warm wind rushed down the side canyon, singing in the pinyons. Above—the blue night sky, powdered with stars. Beside—the rocks, breathing back to the air their stored-up heat of the day. Below—the black void."

At Monument Valley in Utah he beheld the "long walls of sandstone mesas. . . . Before me, the desert drops sheer away into a vast valley, in which strangely eroded buttes . . . tower into a cloudless turquoise sky." He wrote in his diary that there were "two rules in life—never count the cost, and never do anything unless you can do it wholeheartedly."

In letters Everett frequently conjured up a romantic vision of his own death. "When the time comes to die," he wrote, "I'll find the wildest, loneliest, most desolate spot there is." An archaeologist in Arizona thought that Everett scrambled across cliffs with a careless disregard for his own safety. Did he tumble to his death from some narrow, slick rock ledge? Possibly, but it seems likely that searchers would have found his body.

Did he orchestrate his own disappearance in an ultimate rejection of the work aday world? Again it seems unlikely; he was too ambitious and too devoted to his family. Could the boy who described himself as "roaring drunk with the lust of life and adventure and unbearable beauty" commit suicide? The most plausible theory is the most squalid—that Everett was robbed and killed by rustlers known to operate around Escalante.

"A few days ago I rode into the red rocks and sandy desert again," he wrote in his last letter, "and it was like coming home. . . . Often as I wander, there are dream-like tinges when life seems impossibly strange and unreal. I think it is, too, only most people have so dulled their senses that they do not realize it."

We are left with the mystery and a tragic sense of loss, of potential unfulfilled and genius unrealized.

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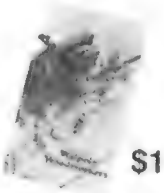

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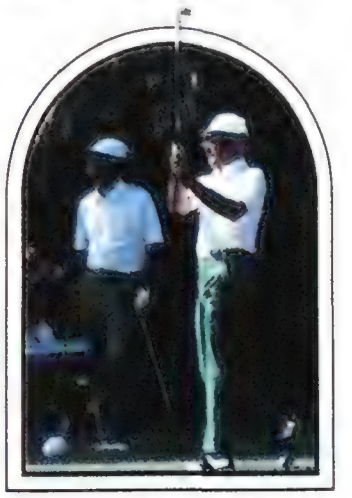

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Additional reading

Structures (p. 56)

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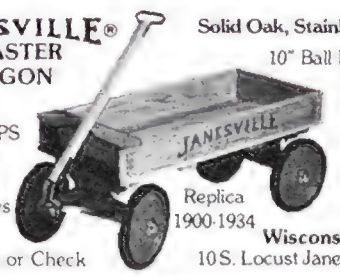

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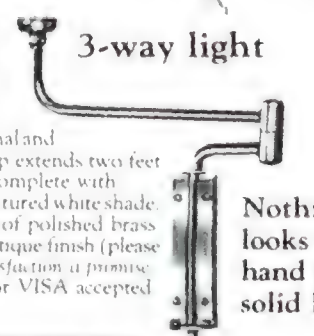

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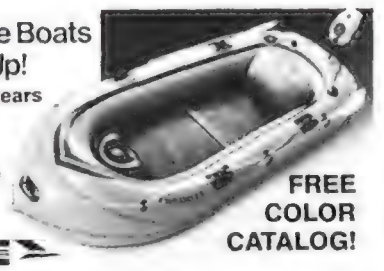

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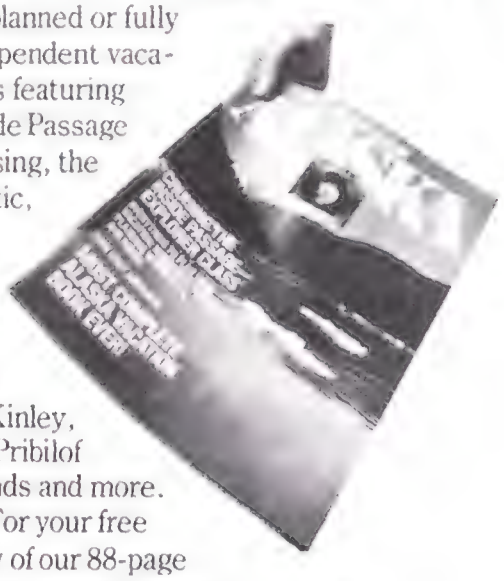

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Special March exhibits and events

National Air and Space Museum
Orion: The Inside Story (March 10; 9 A.M.) Monthly sky lecture.
The Air War in Korea (March 15; 7:30 P.M.) Lecture by Lt. Gen. E. C. Blesse, USAF (Ret.).

Renwick Gallery
Fanfare (through July 8) Evolution of 18th-century European fans.

Cooper-Hewitt Museum (New York)
Embroidered Samplers (through May 27) Nearly 200 samplers from the museum's collection. See *Highlights continued.*

National Museum of Natural History
Exploring Microspace (March 15-July 15) Features 100 scanning electron microscope (SEM) photographs and an operating SEM machine.
Art of the Cameroon (through June 17).
N!ai, the Story of a !Kung Woman (March 2; noon; Baird Auditorium) Film.

Hirshhorn Museum & Sculpture Garden
Art from Italy: A Selection from the Museum's Collection (through April 8).
Drawings: 1974-1984 (March 15-May 13) Presents 150 drawings by 30 artists.

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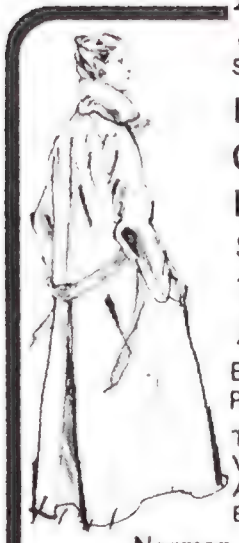

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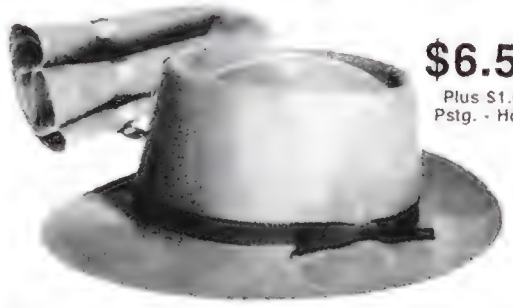

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Freer Gallery of Art

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The Noho Theatre Group (March 27; 7:30 P.M.) A fusion of Japanese theater with Western literary tradition.

Genetics: Inheritance and Hope (March 29) All-day seminar.

David (March 22; 7:30 P.M.) Washington premiere of film about the Holocaust.

20th Century Consort (March 17; 5:30 P.M.) Features three world premieres.

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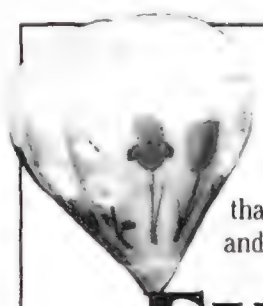

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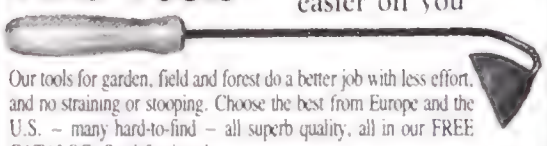

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tution Avenue N.W., Washington, D.C., on April 27-29, 1984. The hours will be 10 A.M. to 6 P.M. Admission is $4.50 ($3.50 for Smithsonian Associates, seniors over 65 and children under 12). Group advance sales may be arranged by writing to Mrs. J. Edward Day, 5804 Brookside Drive, Chevy Chase, Md. 20815.

Twelfth Musical Weekend

Among the highlights of the Twelfth Musical Weekend, being held this year April 27-29, will be the Metropolitan Opera performing Mozart's *The Abduction from the Seraglio*; a concert using 18th-century instruments from the Smithsonian's outstanding collection; and a champagne breakfast with music in the Bird House of the National Zoo. For details, and to make reservations, write: Musical Weekend, Room 4124, NMAH, Smithsonian, Washington, D.C. 20560.

Smithsonian Institution Traveling Exhibition Service

SITES circulates exhibitions to hundreds of cities outside Washington. To sponsor a show in your community, write: SITES, Smithsonian, Washington, D.C. 20560. Here are some March exhibits:
New London, Connecticut (March 24-April 22) *Marine Mammals of the World*, Thames Science Center.
Montgomery, Alabama (March 24-April 22) *The Lithographs of James McNeill Whistler*, Museum of Fine Arts.
Boston (March 1-May 31) *Ban Chiang: Discovery of a Lost Bronze Age*, Museum of Science.
Patterson, Ohio (March 24-April 22) *Black Wings: The American Black in Aviation*, U.S. Air Force Museum.
Dallas (March 31-May 27) *A Celebration of Birds: Louis Agassiz Fuertes and His Art*, Museum of Natural History.

Membership benefits when visiting the Smithsonian

Add to the pleasure of your visit by planning ahead: a fact-filled pre-visit packet is free; send postcard request or phone Associates' Reception Center, Smithsonian Institution, Washington, D.C. 20560, (202) 357-2700; for hearing impaired, TDD (202) 357-1729.

Upon arrival, begin your visit at the Associates' Reception Desk in the castle, staffed daily 10 A.M. to 4 P.M. Special printed materials are part of the cordial welcome as are full details of your benefits which include a half-hour slide/lecture orientation to the 13 museums; dining in The Court; discounts in most Smithsonian shops.

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Three not so easy pieces

At the Cooper-Hewitt, young girls' samplers from the world over reveal patience and occasional frustration

Many Americans think that samplers were invented in this country, but needlework exercises have actually been practiced for centuries by young girls in Europe, Asia, Africa and elsewhere. Whether stitched in the home or as a project in school, the sampler was a way for a girl in any culture to learn useful skills. When finished, it might be hung by her family as proof that she was "well educated"; or her children might eventually use it as a doll's blanket. An exhibition at the Cooper-Hewitt, "Embroidered Samplers," includes nearly 200 of them, sewn by girls age eight and over.

For young learners everywhere, says exhibition curator Gillian Moss, "getting the graphics to work was part of the challenge. You sometimes see reversed numbers or the lines don't always work out correctly." Eleven-year-old Lucy Lathrop is a case in point (below). It's one thing to leave out a letter of the alphabet—who reads every letter, anyway? But after all that assiduous stitching, to get to the last line and realize you're running out of space—what a sinking feeling! The solution, says curator Moss: "She just squished the last word in as best she could."
Constance Bond

Among 200 samplers in the Cooper-Hewitt show are: at far left, 17th-century English tour de force by girl with initials "SI" (top); above, sampler by 11-year-old Lucy Lathrop of New York or Connecticut, about 1800; and near left, sophisticated rendering (detail) by Abigail Mears, Massachusetts, 1772.

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Domestic Study Tours

Crafts Today April 26-29: "Glorious Glass"—Come to the Smithsonian for the 1984 Forum on 20th-Century American Glass.

Civil War in Virginia May 2-11: Explore historic homes, towns and battlefields during springtime in the Shenandoahs.

Arches and Canyonlands National Parks May 10-17 or September 20-27: In southeast Utah, discover the beauty of deserts and canyons. Includes jeep trips and a one-day Colorado River raft trip.

California Dream May 17-25: Travel from San Francisco to Sacramento and Carmel focusing on writers who shaped the early image of the state.

Kentucky May 17-25: Visit historic homes in Louisville, Lexington and Shakertown. plus renowned craft centers in Berea.

Crow Canyon Archaeology May 20-27 or August 5-12: Join archaeologists near Mesa Verde, Colorado, for a dig at an ancient Indian site.

Treasure-Houses of Early America May 31-June 7: Private tours of Winterthur and other historic homes and museums around Wilmington, Delaware.

Connecticut Antiques June 17-24: Tour New England's scenic countryside visiting 18th-century villages, antique collections and private homes.

Family Weekend June 27-July 1: A special program to share the treasures of the Smithsonian and the monuments of the capital with your children ages 7 to 14.

Waterton-Glacier International Peace Park July 17-28: Hike through spectacular Rocky Mountain scenery with overnights at park lodges and chalets.

Journey on the Green River July 20-30: Master the skills of white-water river running in your own Sportyak through Utah's dramatic canyon country.

Geology in the Colorado Rockies July 29-August 4: Join geologists in the Pikes Peak area to study two billion years of Earth's history.

Yosemite's High Country August 4-11: From a base camp near Tuolumne Meadows explore the remote areas of the Sierras.

Colorado Railroad and Mining History August 10-18: Ride steam trains on scenic mountain railroads, sleep in Victorian inns and explore old mining towns.

In August . . . enjoy rafting on the Salmon River's Middle Fork or through the Grand Canyon on the Colorado River.

Washington "Anytime Weekend": Plan a spring weekend to visit the Smithsonian museums. Package includes hotels, meals and exclusive tour of Smithsonian castle. Reservation and payment must be received at least ten days prior to arrival.

Foreign Study Tours

These tours range in size from small group experiences to charter adventures and vary in price from low-cost to deluxe, depending on the type of travel, destination and length of trip:

People's Republic of China, 1984: Retrace the Silk Route, climb China's sacred peaks, cruise the Grand Canal or Yangtze River, explore back roads, study decorative arts and antiques, or journey by train through the countryside. Exclusive tours are led by a Sinologist and include intensive pre-tour briefing.

Rouen and the Norman Countryside March 31-April 15 or October 6-21: The ancient city of Rouen, capital of lush Normandy, provides a superb setting for walking tours, museum visits and special excursions nearby.

Canals and Old Masters April 10-24: Art museums, historic tours and spring flowers highlight Amsterdam. Then sail by river-boat to explore medieval Belgian and Dutch port cities, plus Brussels.

London and the English Countryside April 29-May 13: Delve into London's 2,000-year heritage with lectures, walking tours and theater followed by travel excursions through England's spring countryside.

History and Romance of the Rhine May 14-29: Following a program in Zurich and Basel, embark on our chartered ship for a seven-day study voyage to the great castles and cathedrals on the Rhine.

Swiss Countryside May 26-June 10 or September 1-16: Explore the majestic, romantic mountain world of Switzerland's Bernese Oberland while residing in Lenk.

Wild Highlands of Scotland May 31-June 18: Based in a castle, observe shy wildlife and the brooding landscapes of loch and moor. Visit the Isle of Skye and meet local residents to learn about this remote and historic region.

Siberia and Beyond June 10-July 3: Take the legendary train across beautiful eastern Siberia followed by a choice of travel seminars to seldom-visited Outer Mongolia, exotic Central Asia or the czars' cities of Moscow and Leningrad.

Greece June 16-July 1: A full program in Athens is followed by visits to the sites of ancient civilizations in central Greece and Thessaloniki.

Cotswold Countryside June 24-July 8 or July 8-22: Stay in Cirencester, in the midst of England's ancient green hills, and visit archaeological sites, market towns, woolen mills and historic homes.

Iceland July 24-August 7: Travel a rugged terrain of glaciers, hot springs and majestic waterfalls. Visit outpost fishing and farming communities to meet today's pioneers of the Far North.

Island World of Britain July 30-August 13: From Southampton, circumnavigate Great Britain aboard the *Argonaut*.

Scandinavia and the Baltic August 4-18: Begin in Copenhagen, gateway to the Baltic, then board the *Illiria* for port calls at enchanting Baltic islands and the impressive cities of Tallinn, Leningrad, Helsinki and Stockholm.

Kenya August 9-26: Observe wildlife on exciting safari to Masai Mara, Amboseli, Lake Nakuru, Kilaguni and Lewa Downs.

Oxford/Smithsonian Seminar September 14-29: Attend classes, lectures and field trips led by Oxford faculty while enjoying the special ambience of this famous university and town.

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n Washington

Selected Studies Seminars

Enjoy the treasures of the Smithsonian in unique, popular programs and special behind-the-scenes tours. Choose from:

Connoisseurship of Rugs April 8-13: Experts use masterpieces from outstanding museum and private collections to illustrate the many rich historical designs and techniques which are greatly admired—and sought after—today. Also includes tours at the renowned Textile Museum in Washington, D.C.; museum and commercial care and repair of fine rugs; and a round-table discussion of participants' rugs, and prized rugs which are collectible today. Speakers include Patricia Fiske, director of the Textile Museum, and Walter B. Denny, author of *Oriental Rugs*.

Gardens by Design April 29-May 4: Celebrate spring in the outstanding gardens of the Washington, D.C., area with their profusion of flowering shrubs, trees and plants. Experts focus on the art of planning and designing gardens—whether small or large, public or private—in in-depth lectures and tours of major horticultural sites in and around Washington.

In Tucson, Arizona

The New Astronomies May 6-11 or May 13-18: Springtime in Arizona at two of the most advanced scientific research facilities in the world: the Fred Lawrence Whipple Observatory (formerly Mt. Hopkins) and Kitt Peak National Observatory with lectures and tours by their directors and eminent staffs.

18th-Century French Art July 15-20: An unprecedented exhibition at the National Gallery of Art of the wistfully beautiful art of Watteau, highlighted by the inclusion of his greatest masterpieces from the Louvre and West Berlin, will be the focal point of this seminar taught by William Kloss on the art of France in the Age of Voltaire. Also included in the exhibition and seminar will be paintings, drawings and prints from great American and European public and private collections.

Coming in the fall:

History of American Architecture September 30-October 5
Digging up Rome October 14-19
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By Jack Fincher

If a machine answers, maybe you should *hang up*

Hello, this is Jack Fincher speaking. I'm out right now—of all patience. So please: *Don't* leave your name, your number or your message. As one of some six million Americans possessed by a telephone-answering machine, I've about decided enough is too much. My life hasn't been the same since I bought mine. Or to put a finer point on it, since you bought yours.

My beef is twofold. On the one hand, I've learned to talk back to your machine briskly, not to be intimidated by its silently spinning reel of recording tape, and even to respond without being buffaloed in the least by a few inert transistors. But I can never be sure about you. You, I think, could benefit from a few tips on how to cope. The problem is general enough so that *Seventeen* magazine, the bible of teenage know-how, recently took pen in hand to offer a few tips.

First and foremost, *Seventeen* admonishes, if a machine answers, don't hang up. (People do. I'm told half the French phone owners in a recent national survey said they refuse to address a telephone-recording machine at all, either formally with *vous* or informally with *tu*—let the Académie Française make of that what it will.) After all, *Seventeen* asks most reasonably, you did phone, didn't you? So pay attention to what my machine has to say. Wait for the beep. Speak in a clear, firm voice. Be brief and to the point. Make eye contact. And stop slouching.

Good advice, all of it. If more folks followed it, one of my complaints would be obsolete. My major beef, on the other hand (what the French might call *chateaubriand de l'autre côté*), has to do with something far more insidious. I am getting weary, every time I touch-tone my Princess, of being forced to audition a new act for a telephonic amateur night.

At first, getting an unsolicited ticket to the world's tiniest comedy theater didn't seem too much of a burden. I didn't mind, early on, when a friend had me ring up Seattle's Reginald the Plumber, who instructed his callers to write if they had an emergency in his absence, adding that submissions would be judged for "neatness and originality." There was an elemental truth in Reginald's theater of the absurd that appeals to every experienced homeowner. Nor did I fault a New York friend who says, "Hi. There has been a rash of burglaries around here, so I've just stepped out to get some shells for my bazooka. Why don't you leave your number?"

I quickly grew bored, though, with the Joe Miller joke-book monstrosities that followed. There was my friend Sam, who records with unflinching honesty his situation of the moment, then forgets to change it. (*The Guinness Book of World Records* might wish to note that Sam has been in the shower for six months now.) Other correspondents appear to have been getting questionable help from a telephone-answering "ghost writer," one Rick Campbell of Portland, Oregon, whose frothy booklet, *How to make your Code-A-Phone talk funny*, contains not only how-to pointers but ready-made messages. Two samples:

For lawyers: "If you are being incarcerated and this is your one phone call, leave a message briefly stating the circumstances of your arrest and whether you are innocent or guilty as charged."

For doctors: "Take two aspirin and mail us a check for $10. If you would like us to call in a specialist for consultation, please list your symptoms when you hear the beep."

Things went rapidly downhill from there. Here, for instance, is one of Campbell's soupier messages for lovers: "When I can't see you or touch you the world seems a barren and colorless place. The petals fall from the roses of my heart. High-flying birds cry out." (Captive Audience fwowed up.)

In a rare moment of humility, Campbell suggests that if you don't like his prose, try writing your own, remembering, however, that a slice of wry beats a broadside to the sweetmeats every time. Change your routines, he advises. And keep it clean; obscenities are against the law. (Tell *that* to the much-publicized number in San Francisco allegedly offering a 30-second blue movie-of-the-air.) Aim some of your messages at those who call frequently, Campbell concludes, barbing your remarks accordingly.

I tried. But everything came off either cruel or insipid. From there it was only a direct dial to Linda Marroquin, an entrepreneur in Houston whose business, Call Me Back!, is to produce highly polished miniplaylets that plug right into your machine. They feature pseudocelebrities who range from Bogey (with piano) growling "Play it again, Sam," to an eerily authentic Miss Piggy who trills, "Marry me, Kermie, or set me *free*!"

You can buy your basic cassette of 22 such voices for a mere $15. Or for $125 can sit down with Linda Marroquin in a brainstorming session to pluck from your personality a celebrity you can identify with more easily than any of the above. "Behind many conservative appearances," Marroquin likes to say, "lies a W. C. Fields waiting to be invited out."

W. C. Fields? Wasn't he the guy who said "What hath God wrought?"

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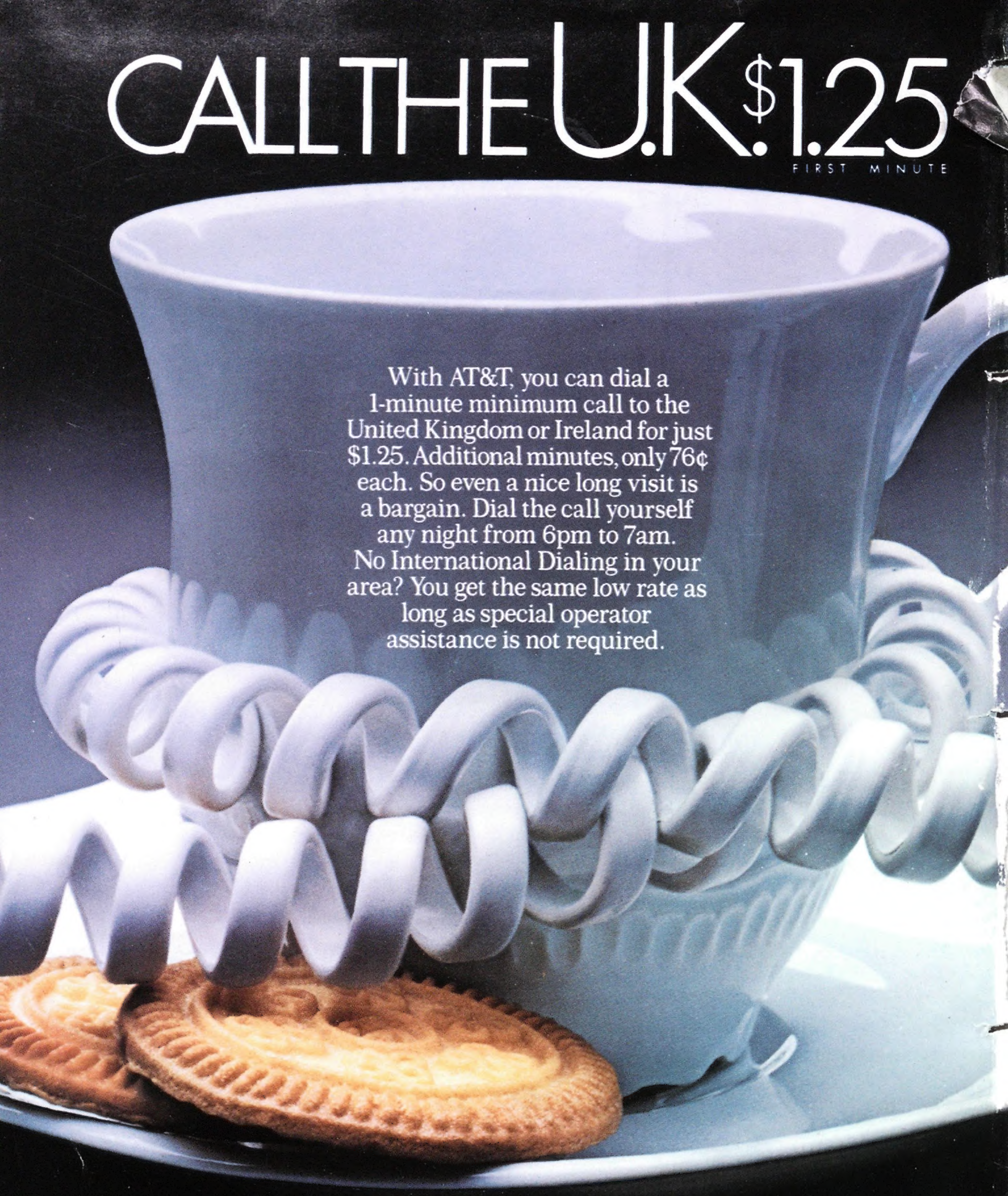

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